Case Discussions in Critical Care Medicine

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First Edition

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Preface

Critical care medicine is an extremely intensive and stressful component of medical practice, and one which is often inadequately covered in undergraduate curricula. Often confused with emergency medicine, critical care medicine deals more with the comprehensive management of critically ill patients rather simply the management of an acute emergency.

This collection of case studies, based on real and hypothetical patients, seeks to introduce many of the fundamental concepts of the practice of critical care medicine. Each case scenario is followed by a series of questions or queries which are discussed in detail. The format follows that of the discussion between an examiner and a student, and is in informal language. This is by no means meant to be a comprehensive textbook on critical care, but the book does seek to provide an interesting and easily readable introduction to the subject.

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Case 01: Chest pain

Mr. T, a 47 year old man was admitted complaining of sudden onset severe chest pain. It started while he was jogging in the afternoon and increased in intensity within 15 minutes. The pain was described as being 'unbearable' with sweating and dizziness. Mr. T had vomited three times prior to admission. He also gave a past history of dyspeptic symptoms with regurgitation. He had been followed up at a medical clinic for control of diabetes and hypertension, and also admitted that he is a heavy smoker. Mr. T's father had died of a 'heart attack' when he was 45 years old.

What is the primary diagnosis that should be considered?

Ischaemic chest pain; acute coronary syndrome

What are the risk factors for an acute coronary event in this patient?

He has both non-modifiable and modifiable risk factors. The non-modifiable risk factors are;

- Male sex
- Family history

His modifiable risk factors are

- Hypertension
- Diabetes mellitus
- Smoking

What are the differential diagnoses?

- ST elevation MI
- Non ST elevation MI
- Dissection aortic aneurysm
- Unstable angina
- Severe gastroesophageal reflux disease
- Pneumothorax

However, his history is very suggestive of an acute coronary event, and it is important to exclude this first.

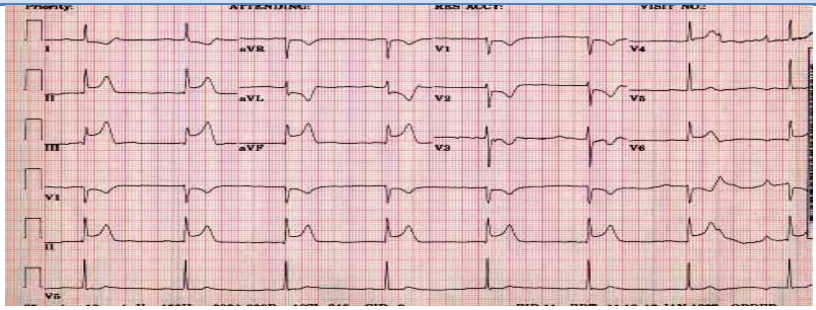
If you are the attending doctor in the emergency unit what are your priorities on admission?

- High flow oxygen via face mask
- Vascular access
- Adequate pain relief – IV morphine 2.5 – 5 mg stat
- Assess the patient
    - Level of consciousness
    - Haemodynamic stability (Pulse rate, rhythm, blood pressure, JVP, bilateral crackles in lungs, peripheral circulation)
    - Brief history
- Exclude other differential diagnoses with history and examination

If you suspect an acute coronary event what other steps would you take at this stage?

- Obtain an urgent ECG
- Connect to cardiac monitor
- Give Aspirin 300mg to chew
- Give Clopidogrel 300mg stat
- Give Atorvastatin 40mg stat
- Monitor the haemodynamic stability of the patient closely

Mr. T's ECG was available in 15 mins. It showed ST segment elevations in leads LII, LIII and aVF. What is your diagnosis?



Inferior ST elevation MI.

What other tests would be useful for your assessment of this patient?

Full Blood Count – To check Hb level (anaemia can be the cause as well as an aggravating factor of acute coronary events)
Serum electrolytes – Changes in electrolytes can cause sudden cardiac arrest. Potassium should be monitored and corrected if low or high.
CRP – It is a marker of inflammation. A high CRP is an indicator of subsequent ischaemic events
Serum creatinine –Important to assess before starting ACE inhibitors (ACEI) or angiotensin receptor blockers.

What is the role of cardiac enzymes in assessment of an acute coronary event?

There are three different enzymes that are assessed

- Troponins
- Lactate dehydrogenase
- Creatinine kinase (MB fraction)

Cardiac Troponins
This is the most widely used marker of myocardial damage. It rises after 6 hours of infarction and remains elevated for about 14 days. Troponin I has the greatest sensitivity and specificity for detecting myocardial damage. It is not found in serum and is released only when myocardial necrosis occurs
CK –MB
Rises after 4 hours of injury, levels peak around 18 to 24 hours after injury and remains elevated for 3-4 days
LDH
Reaches a peak in 3-6 days after MI. Subsides within 8 – 12 days

How useful is a chest X-ray at this point?

It serves no diagnostic purpose, but can be helpful to exclude left ventricular failure and other differential diagnoses such as pneumothorax, or pleural effusion.

What are significant changes in ECG in MI?

- High probability of MI - ST segment elevation greater than 1 mm in 2 anatomically contiguous leads or the presence of new Q waves or recent onset LBBB.
- Intermediate probability of MI - ST segment depression, T-wave inversion, and other nonspecific ST-T wave abnormalities.
- Low probability of MI - normal findings on ECG

Mr. T's infarction was classified as an inferior wall infarction by looking at ECG changes in LII, LIII and aVF. How would you differentiate infarcts in other areas of the heart?

LII, LIII and aVF	Inferior wall
I, aVL, V_4 to V_6	Lateral wall
V_1 to V_3	Anteroseptal
V_1 to V_6	Anterolateral
RV_4, RV_5	Right ventricular
T wave changes in V_8 and V_9 R/S ratio > 1 in V_1, V_2	Posterior wall

Following arrival Mr. T was managed as follows;

- Supplementary Oxygen
- IV access with two large bore cannulae
- IV morphine for pain relief
- Blood sent for basic investigations and troponin
- Urgent ECG available with above mentioned changes
- Aspirin and clopidogrel loading doses given

What is the next step in management?

Thrombolysis with streptokinase or tissue plasminogen activator

When will you consider thrombolysis?

- Typical chest pain plus ECG evidence of ST segment elevation of more than 1mm in 2 contiguous leads or new onset left bundle branch block or ST depression in anterior leads suggesting posterior infarction should prompt the attending doctor to start thrombolytics.
- Cardiac markers are not essential to start thrombolytics.

How will you give streptokinase to Mr. T?

Exclude contraindications first;

- Documented hypersensitivity
- Active internal bleeding
- Intracranial neoplasm, aneurysm
- Bleeding diathesis
- Severe uncontrolled arterial hypertension

IV streptokinase 1.5 MU was administered in 200ml of normal saline over 60 mins.

What are the other treatment options available?

- PTCA (Primary transluminal coronary angioplasty)
- Use of other thrombolytic agents such as t-PA, alteplase

What is meant by the "door to needle" time and 'door to balloon time'?

Door to needle time is the time lapse from arrival at the treatment center to administration of thrombolytics. Similarly, time taken from arrival to angioplasty is the door to balloon time. Ideally the door to needle time should be less than 30 mins and door to balloon time less than 90 mins. Thrombolytics are most effective when given within 2 hours of infarction.

What other drugs would you consider at this stage for Mr. T?

- Beta-blockers – To control the heart rate and reduce myocardial oxygen demand. The beta-1 antagonist metoprolol is the ideal (if not contraindicated). Beta-blockers reduce the rate of re-infarction and have a survival benefit.
- Nitrates – Have no survival benefit, but can be given for symptomatic relief if blood pressure is not compromised.
- ACE inhibitors – Have survival benefit. Especially beneficial if the ejection fraction < 40% or if left ventricular failure (LVF) is present.
- Angiotensin receptor blockers can be used when patients are intolerant of ACEI.
- Heparins – Not indicated in ST elevation MI if streptokinase is given, but has a useful adjunctive role if used with alteplase, reteplase etc.
- Calcium channel blockers – No survival benefit, may even increase mortality. Verapamil and diltiazem should be avoided in left ventricular failure with pulmonary oedema.
- Continue aspirin, clopidogrel at 75 mg nocte and Atorvastatin 10 – 20 nocte.

Mr. T was started on aspirin, atorvastatin, clopidogrel, a beta-blocker and captopril. He was admitted to coronary care unit for close monitoring.

What complications can he develop?

- Tachy or brady arrhythmias
- Cardiogenic shock
- Valvular / septal rupture
- Congestive cardiac failure
- Ventricular rupture
- Pericarditis
- Mural thrombus
- Ventricular aneurysm

What factors would determine the prognosis of Mr. T?

A good prognosis is indicated by;

- Successful early reperfusion
- Treating with loading doses of aspirin, clopidogrel and a statin with continuing of same drugs, beta blockers and ACEI as suitable
- Preserved LV function

A poor prognosis is indicated by;

- Delayed and unsuccessful reperfusion

Case 02: Chest pain

Mr. S, A 65 year old retired clerk developed sudden onset severe chest pain while reading the newspaper in the morning. He had been having on and off chest pains in the past, but the frequency and the intensity had worsened recently. He was taken to hospital. While taking the history the doctor learned that Mr. S was a hypertensive and a diabetic, and had been diagnosed to have stable angina. He had also smoked 30 cigarettes per day for 20 years. An urgent ECG showed down-sloping ST segment depressions in leads V1 to V4.

What is the primary diagnosis that should be considered?

Ischaemic chest pain; acute coronary syndrome

How will you assess the patient?

See Case 01

Cardiac troponin done after 10 hours since onset of chest pain was negative. What does that mean?

This indicates that, though the pain is ischaemic in nature, there is no significant myocardial necrosis. Thus, this episode may be a one of unstable angina.

What is unstable angina?

Ischaemic type of chest pain that is

a) worsening in severity
b) occurring more frequently
c) occurring at rest
d) of recent onset

What investigations would you do?

- Urgent ECG, repeated at regular intervals if the pain persists.
- Chest X-ray
- Random blood sugar (capillary blood glucose)

- Lipid profile
- Full blood count
- Renal function tests

How will you manage this patient?

- Assess the cardiovascular risk of the patient
- Antiplatelet drugs
    - Loading – clopidogrel 150mg, aspirin 300mg
    - Maintenance- clopidogrel 75mg, aspirin 75mg daily
- Atorvastatin, a beta blocker and ACEI if no contraindications
- Oral nitrates

Several hours later, his ECG shows ST segment depressions and T wave inversions in leads V1 – V6). Repeat cardiac troponins were positive. What is the type of acute coronary syndrome you will diagnose now?

Non ST elevation MI (NSTEMI)

What is the basic pathological difference between STEMI and NSTEMI?

In STEMI there is through and through infarction of cardiac wall giving rise to characteristic appearance on ECG. In NSTEMI there is mostly subendocardial infarction.

How would you manage a NSTEMI?

In addition to the above, subcutaneous low molecular weight heparin or subcutaneous/intravenous unfractionated heparin should be given. (e.g – Enoxaparin 60mg SC twice daily)

Ideally, this patient should be managed in a coronary care unit. Early angiography should be considered if the chest pain persists.

What is the management of acute coronary events after the acute stage?

- Bed rest for 24 – 48 hours
- Liquid diet for first 48 hours and then gradually convert to semi-solids and solids
- A limited stress test is indicated prior to discharge in the case of unstable angina. If it is positive, a coronary angiogram is indicated
- Depending on the findings of the coronary angiogram, either angioplasty and stenting, or coronary artery bypass grafting may be indicated
- It is important to ensure compliance with the drugs which will improve long term survival, namely; aspirin, clopidogrel, ACEI or ARB, beta-blocker and statins
- The patient should be advised on lifestyle modification: low fat, low salt diet, with regular exercise (brisk walking 30 minutes a day 2 – 4 times a week)

Case 03: Severe hypertension

Mrs B, A 64 year old female was brought to medical casualty with alteration of level of consciousness. On admission she was drowsy and had 2 episodes of generalized tonic clonic seizures 20 mins ago. Prior to the seizure, she had complained of double vision and visual haloes. On examination she was drowsy but afebrile. Her blood pressure was 230/130 mmHg. There were bilateral crackles in the lung bases and a gallop rhythm on auscultation. Her saturation was low. When questioned in detail on medical history, it was revealed that she had been diagnosed to have hypertension with chronic pyelonephritis of both kidneys. However she had defaulted treatment for the past 3 months.

What is a hypertensive emergency?

Severe hypertension with target organ dysfunction. Immediate lowering of blood pressure is necessary to save target organ function.

What is hypertensive urgency?

A rapid rise in blood pressure without any target organ damage. Blood pressure reduction over days would suffice.

What are the target organs commonly involved in hypertensive emergencies?

- Cardiovascular system- angina, LVF
- Central nervous system-hypertensive encephalopathy, stroke
- Kidneys- acute renal failure
- Gravid uterus – foetal loss

How can you explain the symptomatology of this lady?

Chronic pyelonephritis is an identified cause of chronic kidney disease and end stage renal failure. With destruction of renal tissue, its contribution to control of blood pressure (by

regulation of water and electrolyte balance and the renin-angiotensin-aldosterone axis) diminishes, resulting in hypertension. Uncontrolled hypertension will damage the vasculature of target organs resulting in endothelial injury, fibrinoid necrosis, platelet deposition and ischemia. This vicious cycle will impair the autoregulatory capacity of the vascular bed.

Loss of autoregulation in renal glomeruli will expose the glomerular vasculature to high pressures resulting in ischaemia. A similar process in cerebral vasculature can result in infarcts, extravasation of fluids and cerebral oedema. The blood brain barrier can get disrupted and fibrinoid material deposition around vessels will result in dilatation of vessels proximal to narrowings, giving rise to microhaemorrhages. These changes will manifest as strokes, seizures, focal neurological deficits, coma and death.

Chronic hypertension will result in an increase in the afterload leading to left ventricular hypertrophy with a compromised coronary blood flow. A sudden surge in blood pressure can further reduce coronary blood flow resulting in myocardial ischaemia and heart failure. This can manifest as acute left ventricular failure with pulmonary oedema.

What are the things you would look for in the history?

- Duration and nature of symptoms (backache: aortic dissection, seizures: cerebral involvement, dyspnoea: pulmonary oedema with left heart failure)
- Diagnosis of hypertension
- Possible causes for hypertension
- Degree of control of hypertension
- Previous admissions of similar nature including ICU admissions
- Target organ damage (strokes, retinopathy, and heart disease)

Co morbidities that can cause secondary hypertension (this is important as in some cases hypertension is reversible)

- Reno vascular disease – fibromuscular dysplasia, atherosclerosis, polyarteritis nodosa
- Renal parenchymal disease – chronic glomerulonephritis, tubulointerstitial nephritis
- Endocrine diseases – thyrotoxicosis, Cushings disease, pheochromocytoma
- Drug interactions – monoamine oxidase inhibitors
- Preeclampsia, eclampsia
- Coarctation of the aorta

What are the things you would look for in the examination?

On general examination

- Evidence of a systemic disease (SLE, endocrinological disorder)
- Fever, icterus, lymphadenopathy to exclude infective causes
- Ankle oedema, features of renal failure

Cardiovascular and respiratory

- Blood pressure in both arms in supine and standing positions if possible
- Evidence of heart failure
- JVP

Abdomen

- Renal bruits
- Abdominal masses

Central nervous system

- GCS and level of consciousness
- Papilloedema
- Focal neurological signs

What are the investigations you would order in this patient?

- Full blood count and blood culture with septic screen to exclude an infective cause for seizures

- Urine full report (UFR) to detect haematuria, proteinuria or active sediments
- Serum electrolytes, blood urea/serum creatinine, random blood sugar; to assess renal function and to exclude any metabolic abnormality for seizures.
- Specific tests to look for an endocrine cause for hypertension
- ECG – ischaemia, LVH
- Chest X-ray- cardiomegaly, rib notching (coarctation), widening of the mediastinum in aortic dissection.
- Echocardiogram- cardiac function, LVH
- CT scan brain – to haemorrhages, cerebral oedema

What are the principles in treatment regarding this patient?

Monitor the blood pressure. Look for target organ damage (History, examination and investigations). If no target organ damage, urgent reduction of BP is not necessary. Rapid reduction of systemic pressure can be harmful as the body is accustomed to high BP over a period of time and a sudden drop may precipitate hypo-perfusion resulting in ischaemia and infarction of vital organs

However, this patient has evidence of target organ damage. Therefore, she has hypertensive emergency. She needs to be managed in an ICU or a HDU (High Dependency Unit). Establish IV access, catheterize and give oxygen. Her blood pressure must to be lowered immediately as it is compromising the function of organ systems. However, rapid correction to normal is dangerous, and can result in cerebral infarction.

Target a mean arterial pressure lowering of 20% of initial value in first hour of treatment (≈40mmHg for this patient). This can be achieved via an IV infusion of a short-acting, titratable, parenteral antihypertensive agent. The target blood pressure thereafter is around 160/110–100mmHg over next 2 – 6 hours. Monitor BP every 30 minutes.

This lady has two organ system involvements. Drugs of choice to use in such situations are:

- For hypertensive encephalopathy
  IV nitroprusside, IV labetolol
- Acute LVF
  IV GTN, IV nitroprusside, IV Frusemide

Once the blood pressure is lowered gradually omit IV drugs and start oral drugs.

What are the drugs of choice that can be used in other hypertensive emergencies?

Emergency	**Drugs**
Acute myocardial ischaemia	IV GTN and beta blockers
Acute renal failure	IV Beta blockers or nicardipine
Eclampsia	IV hydralazine, Magnesium, labetolol
Aortic dissection	IV labetolol
Pheochromocytomas	IV phentolamine or labetolol

See section on strokes for blood pressure control in cerebrovascular accidents

What can you say about the prognosis of patients with hypertensive emergencies with target organ damage?

Five year survival of all patients presenting with hypertensive emergencies is 74 %. 1 year mortality in untreated cases is 79%.

Case 04: Acute pulmonary oedema

Mr. T, a 57 year old patient with ischaemic heart disease (ST elevation anterior infarction) was rushed to medical casualty with shortness of breath. He has had several such episodes during the last two years. The patient was persistently coughing and the sputum was frothy with a tinge of blood. Over the past few weeks, his breathlessness had been worse during the night, and he needed to be propped up with three pillows to sleep. He had also been diagnosed to have asthma. On examination there were bilateral basal crackles in the lungs, together with rhonchi.

What are the possible differential diagnoses?

- Pulmonary oedema
- Acute asthma
- Pneumonia
- COPD

How would you differentiate between Asthma and pulmonary oedema?

The history would give many clues; the age of the patient and the past history of myocardial infarction will favour a diagnosis of left/congestive cardiac failure with pulmonary oedema. The history of paroxysmal nocturnal dyspnoea, orthopnoea, and the blood stained frothy sputum in current episode strongly favours a diagnosis of pulmonary oedema.

A history of bronchial asthma, seasonal and diurnal variation of symptoms, allergies and hypersensitivities, exacerbation of symptoms with upper respiratory tract infections, exercise and cold air would suggest asthma. However, when weighing the evidence for asthma and pulmonary oedema, this particular patient is more likely to have pulmonary oedema.

On examination, an asthmatic patient will have bilateral wheezing. Where as in pulmonary oedema there will be bilateral fine crepitations. There may be accompanying features of heart

failure such as a raised JVP, gallop rhythm, pulses alternans bilateral ankle swelling, hepatomegaly etc. supporting a diagnosis of heart failure
Investigations:

- Chest X ray: cardiomegaly, upper lobe diversion in LVF, hyperinflation in asthma
- ECG: LVH, old ischaemic changes in LVF
- Echocardiogram: cardiac dilatation and reduced left ventricular ejection fraction in LVF

Apart from left ventricular failure, what are the other causes of pulmonary oedema?

Cardiac

- Mitral stenosis
- Mitral regurgitation
- Aortic stenosis
- Aortic regurgitation
- Arrhythmias
- Malignant hypertension

Non cardiac

- Acute respiratory distress syndrome
- Subarachnoid haemorrhage
- Acute/chronic renal failure with fluid overload

What is the immediate management of this patient?

1. Prop up the patient and give oxygen by mask
2. Reassure the patient
3. Attach to ECG monitor to look for ongoing arrhythmias- tachy or brady arrhythmias may need reversion
4. IV morphine 5mg will improve symptoms by reducing anxiety and by its intrinsic venodilatory effect
5. Frusemide 40 to 80 mg IV. Frusemide will have a direct venodilatory effect which acts in around 5 mins while the diuretic activity will take about 30 mins to reach a peak. The immediate relief with frusemide is due to its venodilatory effect

Usually with these measure the patient will improve, if not;

1. For cardiogenic pulmonary oedema further management is guided by blood pressure. (If the blood pressure is low with pulmonary oedema it indicates cardiogenic shock that is unresponsive to diuretics)

Blood pressure (Systolic BP)	**Therapeutic measures**
> 110mmHg	Can start a GTN infusion and continue with further doses of frusemide 40 – 80 mg IV
90 – 110 mmHg	Dobutamine infusion 5 – 20 µg/ kg / min Once the BP picks up above 110 mmHg, frusemide can be given
80 – 90 mmHg	Dopamine infusion 10 - 20 µg / kg / min
< 80 mmHg	Noradrenaline infusion 2.5 µg / kg / min. Increase the dose until BP picks above 110 mmHg

2. The cause of pulmonary oedema has to be treated ; e .g – Left ventricular failure, acute renal failure
3. Continue basic care and monitoring of vital signs

Is nebulization of any benefit in heart failure?

Yes, increased pulmonary venous pressure results in mucosal oedema of the airways, and obstruction of airway (cardiac asthma). This may respond to nebulization.

What further investigations would you would do in this patient?

- FBC – To assess Hb level and white cell count (?pneumonia)
- Renal function tests – To exclude a renal cause for pulmonary oedema
- Arterial blood gas – If patient is not responding to usual therapy – bicarbonate may be needed in severe acidosis to prevent myocardial depression

- Blood culture should be done if infection is suspected
- Fasting blood sugar and lipid profile to assess co-morbidities

The patient's 2D echo showed global hyperkinesia with low ejection fraction (35%). What is his prognosis?

The long term prognosis is poor. The five year mortality is around 50%, and higher in worse degrees of heart failure.

Case 05: Asthma exacerbation

Mr B, 25 year old patient was admitted to casualty unit with severe shortness of breath. On admission his respiratory rate was 32/min and he could not speak in full sentences. The bystander gave history of a cough and sputum production few days ago which led to a wheezing episode that culminated in this severe form. The patient is a diagnosed patient with asthma and was on regular clinic follow up.

What are your differential diagnoses?

- Acute severe asthma
- Pneumonia
- Pneumothorax

On examination he was conscious, rational and afebrile. Lungs were clear with a prolonged expiratory phase and wheezing. The wheezing was bilateral and generalized. The trachea was in midline and air entry was equal on both sides.

What is the most likely diagnosis?

Acute severe asthma

Is this a life threatening attack?

Not by definition.
Life threatening attacks of asthma are identified when
The patient is unresponsive with a silent chest, cyanosed, breathless and has a peak exploratory flow rate that is less than 33% of usual value.
An acute severe attack of asthma is recognized when following criteria are fulfilled

a) patient cannot speak in full sentences
b) Respiratory rate is greater than 25 / min
c) Heart rate is greater than 110 / min
d) Peak expiratory flow rate is less than 50% of best value in health

Therefore this is an acute severe attack of asthma.

How will you stabilize the patient?

A – Attend to airway
B – Breathing, prop up and give oxygen via face mask. Assess need for intubation (i.e. life threatening attack of asthma, respiratory rate < 8 / min, a drop in saturation)
C- Assess the adequacy of circulatory support

What are the steps in management of acute severe asthma?

1. Attend to ABC
2. Use nebulizer bronchodilators, salbutamol 5mg at a frequency of every 20 mins to 6 hours. If response is poor add ipratropium bromide 500µg every 4 to 6 hours
3. Give IV hydrocortisone 200mg stat and start on a oral dose of prednisolone (30 – 60 mg mane)

Usually patients respond to these measures but if not, following therapies can be started in this order

a) IV magnesium sulphate 2g over 20 mins as an infusion.
b) IV aminophylline infusion (750 mg over 24 hrs for a small patient and 1500mg over 24 hrs for a larger body weight)
c) IV salbutamol infusion instead of aminophylline infusion

Despite these measures patient still records a low saturation and is dyspnoiec. What is your next line in management?

- The arterial oxygen saturation has to be assessed by an arterial blood gas.
- A repeat clinical examination of chest and an emergency X ray should be done to exclude a pneumothorax.
- Intensive care units have to be put on alert
- The on call anaesthetist has to be informed
- The final option is to intubate and ventilate under sedation in an ICU with close monitoring

What are the factors on history and examination that would support a diagnosis of acute severe asthma rather than pneumonia?

- History of asthma
- Recent upper respiratory tract infection as a risk factor for exacerbation
- Absence of evidence for consolidation of lungs
- Bilateral wheezing on auscultation and prolonged expiratory flow

What additional steps would you take if you cannot differentiate between asthma and pneumonia?

- Monitor the patient closely
- Chart fluid input output
- Take blood cultures, sputum cultures
- Start on empirical 'best guess' antibiotics (discuss with a microbiologist)
- Chest physiotherapy
- Request full blood count, ESR, Blood urea, serum electrolytes as ancillary investigations

Once the acute episode has resolved how will you manage the patient in the next 24 hours?

Continue oxygen 30 – 60% until the patient is comfortable in room air
Continue nebulizations (with salbutamol 4 – 6 hourly and if necessary with ipratropium 6 hourly) until the patient is comfortable in room air
Treat any underlying infection
Continue oral steroids
Monitor the improvement with peak flow rate assessments and chart (hourly during acute phase and then three times daily)
Repeat serum electrolytes as salbutamol nebulizations may cause hypokalaemia, Supplement K with oral KCl tablets or via an infusion if serum potassium it is less than 3.5 mmol/l

How will you convert the patient to a regimen that can be managed at home?

The acute exacerbation is said to have resolved if

1. the patient can sleep without any disturbance
2. the patient can get about his daily activity without any symptoms
3. Normal exercise tolerance
4. Peak expiratory flow rate > 80% of predicted or best (if measured in past)

- Continue oral steroids until complete resolution (up to a maximum of 3 weeks)
- Convert to oral inhaled steroids 24 hours before stopping oral steroids
- Educate the patient on asthma, possible triggers, treatment, management plan and inhaler technique
- Arrange clinic follow up

How will you determine the drug regimen on discharge?

This is based on the stepwise management of asthma

Step	Description	Management
1	Moving from intermittent infrequent daytime attacks to frequent day and night attacks	Inhaled bronchodilator therapy as required, move to step 2 if more than 2 puffs are necessary per day
2		Low dose inhaled corticosteroids (250 – 500ug of beclomethasone bd) + Inhaled bronchodilators as required
3		Step 2 plus long acting bronchodilator OR leukotriene modifier
4		Same as step 3 but needs large doses of inhaled corticosteroids (1000 – 2000ug / d) with or without a slow releasing theophylline
5		Step 4 plus oral steroids as an additional option

Case 06: COAD

Mr C, 56 year old male presented to medical casualty with acute onset shortness of breath following a productive cough. He gave a history of frequent hospital admissions within the last two years with similar symptoms, but of late, the symptoms had been worsening. He had been initially started on inhaled steroids and bronchodilators, but the response had been poor. He had been a heavy smoker for the past 30 years (20 cigarettes per day). On examination, he was wasted, febrile and had a barrel shaped chest with laboured breathing. The tracheal tug and use of accessory muscles on respiration was clearly visible. There was bilateral wheezing on auscultation.

What is the most likely diagnosis?

Chronic obstructive airway disease (COAD)

What are the two basic types of COAD ?

- Chronic bronchitis
- Emphysema

Chronic bronchitis is a clinical diagnosis. Chronic cough with sputum on most days for 3 months, for two consecutive years is sufficient to make diagnosis of chronic bronchitis.
Emphysema is a histological diagnosis which is defined as irreversible dilatation and destruction of airways and acini distal to terminal bronchioles.

What are the features in this patient favouring a diagnosis of COPD?

- Heavy smoking
- Attacks of shortness of breath not readily reversible with bronchodilators
- Pursed lip breathing, use of accessory muscles for respiration, tracheal tug
- Barrel shaped chest

Thinking in the line of COAD, what would you ask about in history and look for in examination?

History

- Onset and progression of current episode
- Progression of the disease over time and response to bronchodilator and steroid therapy
- Previous hospital admissions including ICU admissions
- Diagnostic criteria for chronic bronchitis
- Co-morbidities
- Impact of the disease on activities of daily living

Examination

General

- Plethora (polycythaemia secondary to chronic hypoxia)
- Cyanosis
- Fever (ongoing infection)
- Clubbing (If present look for another aetiology, not seen in pure COAD)
- Ankle oedema and other evidence of right heart failure (cor pulmonale)

Cardiovascular: (Look for evidence of cor pulmonale, which is a complication of COPD)

- Loud second heart sound
- Parasternal heave
- Pansystolic murmur of tricuspid regurgitaion
- Raised JVP
- Ascites
- Pulsatile liver

Respiratory system

- Respiratory rate
- Tracheal tug, use of accessory muscles for respiration
- Intercostal recessions
- Pursed lip breathing
- Hyperinflation with barrel shaped chest
- Reduced chest expansion
- Hyper-resonant percussion note (over large bullae)
- Bilateral wheeze on auscultation

Is this an infective exacerbation or a non-infective exacerbation of COAD?

This is sometimes difficult to differentiate. The presence of fever, neutrophil leukocytosis, and a high CRP suggests infection. Yellow sputum per se does not necessarily indicate infection, as the colour could be due to eosinophils.

With a working diagnosis of COAD exacerbation, how would you proceed?

- Assess airway, breathing and circulation and correct any correctable cause
- If there is impending arrest, intubate and ventilate
- Give 24% oxygen via face mask
- Nebulize with salbutamol (5mg) and ipratropium bromide (500µg) and assess response.
- Repeat nebulization at regular intervals (Every 20 mins)
- If there is a poor response, give IV aminophylline and IV hydrocortisone as in acute severe asthma
- Start an IV antibiotic after taking blood and sputum cultures (broad spectrum antibiotics covering common upper respiratory tract pathogens e.g. – coamoxyclav and clarithromycin)
- Take blood for urgent investigations
    - Full blood count- look for high Hb (polycythaemia), neutrophil leukocytosis (infection)
    - CRP (high in infection)
    - Serum electrolytes and RBS
- Sputum and blood cultures
- ECG (for evidence of cor pulmonale)
- Chest X ray (to exclude a pneumothorax, to see bullae and evidence for pulmonary hypertension)
- Arterial blood gas (to detect impending respiratory failure)

After 12 hours the patient was still breathless. Arterial blood gas showed an arterial oxygen tension of 60mmHG and a carbon dioxide tension of 70mmHg. The pH was 7.32. What is the type of respiratory failure?

Type II respiratory failure; the oxygen partial pressure is low in both types of respiratory failure. A high pCO_2 indicates type II failure, or ventilatory failure. In type I failure the pCO_2 is normal or low.

How should this be managed?

If the patient is acidotic, assisted ventilation is necessary. If the pH is below 7.35 but over 7.30, non-invasive ventilation, i.e., BiPAP is recommended. If the pH is below 7.30 then the patient should be intubated and ventilated.

What is your long term management strategy?

- The mainstay of treatment is steroids, bronchodilators, antibiotics and oxygen
- In mild respiratory impairment, bronchodilator therapy can be used with salbutamol, ipratropium
- Long acting inhaled bronchodilators such as salmeterol and inhaled corticosteroids will improve symptoms, though they have no effect on survival

Other treatment options in severe COPD

- Long term oxygen therapy
- Surgery – Lung volume reduction surgery in severe emphysema with large bullae
- Pulmonary rehabilitation – A process undertaken by a multidisciplinary team to adjust the patient's way of life to maximize the efficiency of pulmonary function. This includes, modification of working conditions, graded respiratory exercises, health education, stopping smoking and control of co-morbidities.

After an acute episode, antibiotics are continued until the patient is fever free or for 5 -7 days

A short course of oral steroids can be given in steroid responsive patients. (Prednisolone 30mg mane for 7–10 days)

What are the complications this patient might develop during this acute attack?

- Respiratory failure - It is the hypoxia that that keeps the respiratory center stimulated to maintain ventilation. If the hypoxic drive is removed by giving high flow oxygen, this respiratory drive is lost; this results in respiratory depression and carbon dioxide retention, leading to type 2 respiratory failure
- Cardiac tachy-arrhythmias
- Pneumothorax

What are the long term complications he might develop?

- Polycythaemia
- Cor pulmonale

How will you advise him on discharge?

- Advice on use of medication and inhaler devices
- Assess the possibility of home nebulization or availability of such facilities at nearest health care centre
- Needs to stop smoking
- Should exercise regularly according to his exercise tolerance
- Vaccination against Pneumococcus and influenza
- Advice on nutrition if malnourished

Case 07: Pneumonia

Mr H, 56 year old patient was admitted with high fever. He had been well until one week ago. The fever gradually worsened and a dry cough was noticed two days later into the illness. He developed rusty sputum and complained of a stabbing type of chest pain on inspiration. On examination he was very ill, febrile and confused with a GCS of 13/15. There was labored breathing with bilateral crepitations of lungs. The respiratory rate was 12/min. Flapping tremors and papilloedema were present. Severe pneumonia was the working diagnosis.

What are the first steps in management of this patient?

This is a medical emergency and assessment goes hand in hand with investigations and management. First the patient has to be resuscitated. Airway, breathing and circulation have to be assessed and deficiencies corrected. Blood should be taken for culture, FBC, blood urea and electrolytes, ESR and arterial blood gas. An urgent chest X ray and an ECG should be arranged. Once blood is taken for basic investigations, start treatment with empirical antibiotics. The choice of empirical antibiotics will depend on the likely organisms (hospital acquired or community acquired pneumonia) and the prevalent resistance patterns. Liaison with a microbiologist is always helpful. Since this is a community acquired pneumonia, a 3rd generation cephalosporin together with a macrolide is appropriate therapy.

What can be the cause of reduced level of consciousness and papilloedema?

Flapping tremors, papilloedema and reduced level of consciousness can all be explained by carbon dioxide retention and resultant encephalopathy. Severe pneumonia can interfere with air exchange and result in carbon dioxide retention.

The first arterial blood gas done soon after admission read as follows: pH: 7.24, pO_2 (with oxygen) 60mHg, pCO_2 – 54mmHg, HCO_3 (actual) 29.8 mmol/l, HCO_3 (Standard) 30.6mmol/l, Oxygen saturation 85%, Base Excess – (minus) 20.6meq/l
How will you interpret these results?

- A pH of 7.24 and negative base excess indicates acidosis
- This can be due to respiratory acidosis or metabolic acidosis. If it is due to respiratory acidosis the cardinal feature should be carbon dioxide retention. The body would try to compensate for this acidosis by producing more bicarbonate or reabsorbing more bicarbonate in kidneys. Therefore the plasma bicarbonate concentration should be high if there is an attempt of metabolic compensation. The readings in the blood gas report are compatible with these facts.
- The fact that oxygen is low with carbon dioxide retention, signifies a type two respiratory failure
- This patient is in encephalopathy and despite metabolic compensation, the pH remains at 7.24. Therefore this is uncompensated respiratory acidosis

What are other causes of respiratory acidosis?

Respiratory acidosis can occur due to any cause that obstructs or interferes with normal functioning of the respiratory system from cerebral cortex to bronchoalveolar tree and chest wall.
Central nervous system

- Encephalitis
- General anaesthesia
- Cerebral oedema
- Brain tumour
- Cerebrovascular accident
- Poisoning with CNS depressants
- Peripheral nerves
- High spinal cord injury
- Guillain-Barré syndrome
- Tetanus
- Diphtheria

- Neuromuscular junction and muscles
- Diaphragmatic paralysis
- Myasthenic crisis
- Organophosphate poisoning
- Botulism

Chest wall and muscles

- Kyphoscoliosis
- Trauma
- Ankylosing spondylitis

Upper airway obstruction

- Hypopharyngeal obstruction
- Aspiration of foreign body or vomitus
- Laryngospasm
- Angioedema
- Obstructive sleep apnea

Lower airway obstruction

- Generalized bronchospasm
- Severe episode of spasmodic asthma
- Bronchiolitis

Lungs

- Severe bilateral pneumonia or bronchopneumonia
- Acute respiratory distress syndrome
- Severe pulmonary oedema
- Diffuse infiltrative disease (*eg, alveolar proteinosis, interstitial fibrosis)*
- Pneumothorax
- Haemothorax

How will you treat the acidosis?

The mainstay of treatment is reversal of the cause, in this case pneumonia. However in the meantime several life saving measures has to be taken with regard to acidosis and encephalopathy.

The first step is to ensure airway patency; if necessary insert an oral airway, intubate or even request a tracheostomy. Once the airway patency is achieved, give oxygen to maintain an arterial

pO_2 tension above 60mmHg. In the meantime pneumonia should be treated. Monitoring with arterial blood gases may be necessary every 20 – 30 mins in the acute phase. If arterial oxygen partial pressure does not improve above 60mmHg and if that of carbondioxide rises above 60 mmHg, intubation and ventilation is necessary. Correction of acidosis with Na bicarbonate is considered in severe acidosis only. (pH < 7.1) This patient does not require correction of acidosis with bicarbonate but he needs early respiratory support as encephalopathy and haemodynamic instability are indications for noninvasive nasal mask ventilation (NMV) or intubation and standard ventilator support.

Notes on respiratory alkalosis

Hyperventilation can 'blow out' carbondioxide and result in a state of hypocapnia. This is termed respiratory alkalosis. The reduction in H^+ ion concentration in blood is matched by an increase in renal excretion of bicarbonate. This however might take hours to develop when compared with the onset respiratory alkalosis. The onset of alkalosis can either be acute or chronic. Causes of respiratory alkalosis are classified below;

- Hyperventilation due to central phenomena;
- Anxiety
- Brain stem disease such as infarction and haemorrhage
- Hyperventilation due to primary lung pathology
- Pneumonia
- Pulmonary embolism
- Asthma

Other causes of hyperventilation

- Salicylate poisoning: salicylates cause direct stimulation of the medullary chemoreceptors causing hyperventilation
- Pregnancy: It is a cause of chronic respiratory alkalosis due to progesterone induced hyperventilation
- Sepsis
- Liver failure

The clinical picture of respiratory alkalosis can vary. In acute setting with a drastic drop in pH, it can manifest as seizures, tetany or coma. In less intense situations there may be dizziness, circumoral numbness and paresthesiae. Many CNS manifestations of hypocapnia can be explained by cerebral vasoconstriction. The electrolyte disturbances of hypocapnoeic system include hypokalaemia (rarely severe) and a reduction in free ionized calcium. With alkalosis the negative charges on plasma proteins such as albumin is more and this facilitates the binding of free calcium. This state of hypocalcaemia causes the range of clinical features from trousseaus' and chvostek's signs to frank tetany. The vulnerability to respiratory alkalosis is more in critically ill patients who are ventilated.

The mainstay of treatment of respiratory alkalosis is correction of its cause. Temporary bouts of hyperventilation can be helped by rebreathing into a plastic/ paper bag. Close attention must be paid to ventilator settings in paralyzed and ventilated patients to avoid hyperventilation.

Case 08: Metabolic acidosis

Ms Y, a 29 year old female patient was admitted to ward with shortness of breath. She had been diagnosed with chronic renal failure and was dialysis dependent while awaiting transplant. Her last dialysis was 10 days ago and she was scheduled to have another dialysis three days ago, which she had missed. On examination she had deep sighing respiration with a rate of 34/min. She found it difficult to speak and responded poorly to salbutamol nebulization and IV frusemide given at emergency care unit.

What are your major concerns while attending to this patient?

The first priority is to attend to airway, breathing and circulation. Next the presence or absence of life threatening metabolic derangements of end stage renal disease should be excluded. These include;

- Acidosis
- Hyperkalaemia
- Pulmonary oedema and fluid overload
- Uraemia

This patient needs resuscitation. IV access should be achieved with at least one wide bore cannula. Blood should be taken for basic investigations: full blood count, blood urea, electrolytes, creatinine and arterial blood gas analysis. The patient should be catheterized and input/output strictly monitored. An inward ECG and a CXR should be arranged. Elevated JVP, orthopnoea, ankle oedema, and bilateral basal crepitations in lungs will signify fluid overload and pulmonary oedema.
Given the history, it is likely that this patient is acidotic (deep sighing respirations), and in fluid overload. She needs urgent dialysis.

The arterial blood gas of this patient read as follows; pH: 7.14, pO_2 (with oxygen) 98mHg, pCO_2 – 29mmHg, HCO_3 (actual) 9.8 mmol/l, HCO_3 (standard) 12.6mmol/l, Oxygen saturation 98%, Base Excess – (minus) 16.6meq/l. How will you interpret this blood gas report?

- The blood pH is low, indicating acidosis
- The low pH can be explained by either respiratory acidosis or metabolic acidosis. In respiratory acidosis there is likely to be carbon dioxide retention and in metabolic acidosis there is bicarbonate depletion due to uncompensated use of buffer. In this scenario there is in fact bicarbonate depletion but no carbon dioxide retention. These features support a picture of metabolic acidosis. Also, the fact that the patient has chronic renal failure, and has missed a dialysis, makes metabolic acidosis more likely
- The low carbondioxide can be explained by respiratory compensation for acidosis by trying to 'blow out' carbondioxide. That explains the deep sighing respiration (Kussmaul breathing)
- Despite the respiratory compensation there is acidosis, making this a case of uncompensated metabolic acidosis.
- The negative base excess (amount of base required to return the blood pH to its normal value) confirms the diagnosis of metabolic acidosis

Is bicarbonate indicated in this situation?

Use of Sodium bicarbonate in metabolic acidosis is restricted to severe acidosis only as bicarbonate has many untoward side effects. For example it can result in necrosis of tissue in case of extravasation, can cause hypernatraemia or worsen fluid retention if given in excess. This patient urgently needs dialysis. She was dialysed immediately and her general condition improved.

In this patient, chronic kidney disease with inability to excrete a hydrogen load was the cause for metabolic acidosis. What are the other causes for metabolic acidosis?

Increased production of H^+

- Ketoacidosis (diabetes and alcoholism), Poisoning and overdose (salicylates, methanol, sulphur, ethylene glycol, paraldehyde), Lactic acidosis

Inability to excrete H^+

- Type I renal tubular acidosis (Distal type – inability to excrete H), Type 4 renal tubular acidosis, chronic kidney disease

Bicarbonate loss

- Diarrhoea, pancreatic, biliary and intestinal fistulas
- Type 2 renal tubular acidosis

What are the clinical signs and symptoms you expect to find in metabolic acidosis?

Symptoms

- CVS: palpitations, chest pain
- CNS: Confusion, headache,
- RS: Dyspnoea
- GIT: Diarrhoea, nausea, vomiting
- Generalized weakness of body

Signs

- CVS: severe metabolic acidosis can cause ventricular arrhythmias
- RS: Kussmaul respiration, tachypnoea
- CNS: Lethargy, stupor, Coma

What is the anion gap and how is it useful in metabolic acidosis?

The anion gap is calculated as follows;

$AG = (Na^+) - ([Cl^-] + [HCO_3^-])$

The anion gap is useful in differential diagnosis of metabolic acidosis. Acidosis can be with a normal anion gap or an increased

anion gap. Acidosis with a normal anion gap is due to accumulation of H^+ or loss of bicarbonate. Acidosis with a high anion gap is due to exogenous or endogenously produced unaccounted acids. The normal anion gap is between 8–16 meq/l.

Acidosis with a normal anion gap

- Chronic renal failure
- Diarrhoea
- Pancreatic, intestinal, biliary fistulae
- Type 2 renal tubular acidosis (proximal type – inability to reabsorb HCO_3)
- Type 4 renal tubular acidosis (aldosterone resistance)

Acidosis with a high anion gap

- Lactic acidosis
- Ketoacidosis
- Poisoning with salicylates, methanol, ethylene glycol

How will you treat metabolic acidosis?

The general principle is to treat the underlying illness. Once that is done the acidosis will correct itself. Bicarbonate is indicated only in severe acidosis. Unnecessary use of bicarbonate can result in;

- Paradoxical CNS acidosis
- Hypernatraemia
- Volume overload
- Overshoot alkalosis

Specific cases of poisoning may require dialysis.

Notes on metabolic alkalosis

The pathophysiology of metabolic alkalosis can be explained in simple terms. It is the opposite of metabolic acidosis.

Endogenous or exogenous addition of HCO_3 to system: often this is due to inappropriate bicarbonate infusions

Causes:

Loss of H^+ : Severe vomiting and nasogastric tube suction can take out H^+ from the gastric juice. For each H^+ ion lost a

bicarbonate ion enters the extracellular compartment. This tide of HCO_3 influx can result in metabolic alkalosis.
Contraction alkalosis: This phenomenon is observed in chronic diarrhea where there is loss of chloride rich and bicarbonate poor fluid with contraction of extracellular compartment. This leads to an apparent rise in bicarbonate concentration with alkalosis.
Redistribution of H^+ ions between extravascular and intravascular compartments: with hypokalaemia intracellular K^+ moves out of cells and H^+ ions move in to cells to maintain electrical neutrality resulting in alkalosis in extracellular compartment.
Chloride depletion: as with potassium, chloride balance is also closely linked to HCO^-_3 availability. In effect, chloride depletion causes metabolic alkalosis by increasing bicarbonate resorption. Chloride depletion can occur in several ways

- GIT: Chronic diarrhoea, loss of gastric juice with severe vomiting
- Renal: Use of thiazides or loop diuretics

Depletion of chloride is sensed at two places, one is the macula densa of the juxtaglomerular complex which has Na^+-K^+/$2Cl^-$ transporters and the other is the collecting duct B cells with Cl/HCO^-_3 transporters. Low chloride with a low volume status stimulates aldosterone secretion via macula densa and inhibits the Cl^-/HCO_3 antiport in B cells. By both mechanisms renal capacity of bicarbonate excretion is reduced and metabolic alkalosis ensues. However, this type of alkalosis is correctable by replenishing Cl^-, hence the term *chloride responsive alkalosis*.

Causes of metabolic alkalosis can be broadly divided as chloride responsive and chloride resistant based on above mentioned physiological basis
Chloride responsive alkalosis

a) Severe vomiting
b) NG suction
c) Chronic diarrhea
d) Villous adenoma
e) Cystic fibrosis
f) Thiazide and loop diuretic use

Chloride resistant alkalosis

a) With hypertension
    a. Cushing's syndrome
    b. Conn's syndrome
    c. Exogenous corticosteroids and mineralocorticoids
    d. Renovascular disease
b) Without hypertension
    a. Hypomagnesaemia
    b. Severe potassium depletion

Other

a) Milk alkali syndrome
b) Hypercalcaemia
c) Multiple blood transfusion

It is important to ask in history for clues of syndromes causing alkalosis as well as the drug history. Symptoms and signs of alkalosis per se are non specific. There will however be hypoventilation and features of hypokalaemia and hypocalcaemia (tetany, Chvostek's sign and Trousseu's sign). In addition, features of volume depletion may be seen in chloride responsive alkalosis.

Investigations in metabolic alkalosis

Once suspected from clinical history and examination, an arterial blood gas will confirm the diagnosis. There after it is a matter of identifying the nature of alkalosis (chloride responsive or not) and searching for a cause.

Urinary chloride levels are helpful in identifying alkalosis due to volume depletion. Usually in chloride responsive alkalosis the levels are less than 20meq. Rest of the investigations depend on clinical picture and whether it is likely to be chloride dependent or resistant alkalosis. In chloride resistant cases investigating in lines of adrenal disorders like Cushing's diseases and hyperaldosteronism is warranted.

The mainstay of treatment in metabolic alkalosis is correction of the cause. In chloride responsive states the cause should be treated as appropriate. (e.g. – antiemetics in case of vomiting,

proton pump inhibitors to reduce gastric acidity if applying NG suction, resection of adenomas of colon, stopping potassium losing diuretics and if that is not feasible, addition of a potassium sparing diuretic). In the meantime volume depletion should be corrected with a normal saline infusion. It is better to add potassium supplementation as these patients are hypokalaemic as well.

In case of chloride resistant alkalosis due to Conn's or Cushing's disease, primary adrenal tumour should be resected and in case of a pituitary adenoma, hypophysectomy is necessary. In the meantime, potassium sparing diuretics are used.

Case 09: Hyponatraemia

Mr U, a 65 year old male was admitted to a medical ward with reduced level of awareness. He was well one week ago, when he developed altered behaviour. He was withdrawn and preferred to stay in bed. During the next 48 hours he became confused and drowsy when the family decided to bring him to the hospital. He was a diagnosed patient with diabetes mellitus for 6 years and was on glibenclamide 5mg twice daily and metformin 500mg thrice daily. Six hours prior to admission the patient had fallen from bed. On admission his GCS was E–3, V–4, M–5. The patient was drowsy but there was no neck stiffness or focal neurological signs. The fundi were normal in appearance. He was afebrile.

What are the possible causes for drowsiness in this patient?

- Hypoglycaemia
- Electrolyte imbalance
- Drug overdose
- Head injury with intracranial bleed
- Stroke
- Liver or renal impairment

What are the immediate measures you would take if you are the attending doctor in the emergency unit?

- Assess airway, breathing and circulation
- Check capillary blood sugar
- Establish IV access and take blood for serum electrolytes, liver function tests and renal function tests
- Take a short history and do a quick system examination that includes vital signs and GCS
- Take an ECG
- Take a detailed history and perform a detailed examination when the patient is stabilized
- Do a CT scan if the patient is not improving and if GCS is deteriorating

What are the things you would ask in the history?

- Onset and progression of symptoms
- Possibility of underlying infection (Fever, rashes, contact history, symptoms such as dysuria, travel history, exposure)
- Comorbidities and drug history, possibility of an overdose
- History of similar episodes previously
- Depression, suicidal ideation
- History of trauma, falls

What are the key features to look for in examination?

Fever, cyanosis, icterus, pallor, lymphadenopathy, injuries
CVS-Pulse, Blood pressure, murmurs, carotid and renal bruits, evidence of heart failure
Respiratory - Evidence for a chest infection
Abdomen- Evidence of liver or renal impairment (ascites, organomegaly)
CNS- Neck stiffness, focal neurological signs, cranial nerve palsies, fundi

The capillary blood glucose was 124mg / dl. The results of other basic investigations were available in 6 hours. Hb:11.8g/dl, WBC:8700/µl, N–67%, L–28%, Na– 118 mEq/l, K–3.9 mEq/l, blood urea-5.6 mmol/l, AST/ALT-normal.

What is the likely cause for drowsiness?

Hyponatraemia. A serum level of Na^+ less than 135 meq/L is defined as hyponatraemia and it is considered severe when the serum level is below 125 meq/L.

How do you classify the causes for hyponatraemia?

There are a multitude of causes for hyponatraemia, but the following classification can be used to categorize the causes. Basically, the reduction in sodium concentration can be either due to excessive dilution or excessive loss of electrolyte or both.

Hyponatraemia can occur on a background of normal osmolality, hyperosmolality or hypo-osmolality.
The plasma osmolality can be approximated by the following equation.
Osmolality= Na^++ serum glucose/18 (mg/dl) + BUN/2.8 (mg/dl)

Hypertonic hyponatraemia
As it is obvious, a rise in serum glucose (poorly controlled diabetes) or urea (renal impairment) will cause a hyperosmolar situation in which there will be a relative drop in Na^+ concentration. A rise of serum glucose by 100mg/dl (above 100 mg / dl) marks a drop in serum Na^+ by 1.6 meq/l. At higher glucose concentrations this relationship is not linear.
Normotonic hyponatraemia
This occurs when there is a paraproteinaemia or a dyslipidaemia. In this situation proteins or lipids amount to a significant amount of plasma and the proportion of water is relatively less. At the same time though the Na^+ concentration in water partition is the same, as the fraction of water is now less when compared to the whole volume of plasma, there is a relative drop in measured Na^+ content as well. This phenomenon is called pseudohyponatraemia as this low Na^+ value is an artifact depending on the method of measurement.
Hypotonic hyponatraemia
This is the commonly encountered variety of hyponatraemia. There is always a deficit in between Na^+ excretion and free water clearance. Again, hypotonic hyponatraemia can be classified as hypovolaemic, normovolaemic and hypervolaemic depending on the volume status.

- Hypovolaemic hypotonic hyponatraemia: This simply implies that in addition to the volume depletion there is also salt loss. Volume depletion causes less stretch in volume receptors (atrial, pulmonary and venous stretch receptors) which activates the sympathetic outflow. Sympathetic stimulation activates the renin angiotensin axis and also results in increased secretion of antidiuretic hormone. Angiotensin is a powerful stimulant of thirst

and it also causes Na^+ and water resorption in proximal tubules limiting the amount of solutes reaching the distal part of nephron. ADH increases the amount of water reabsorbed via the distal tubules and collecting ducts. All these activities can result water retention in excess of Na and hence hyponatraemia. Examples of this clinical picture include: severe haemorrhage, diarrhoea, vomiting etc.

- Hypervolaemic hypotonic hyponatraemia: Here the patient is volume overloaded and there is a defect in free water clearance. Examples include cirrhosis of liver, renal failure, severe hypoproteinaemia and congestive heart failure. But it is important to remember that though the patient is overloaded most of the water may in fact be extravascular. Hence there is intravascular volume 'depletion' triggering all the compensatory mechanisms mentioned in hypotonic hypovolaemic hyponatraemia.
- Normovolaemic hypotonic hyponatraemia: This is a common presentation in hospital setting. It is caused by syndrome of inappropriate secretion of antidiuretic hormone (SIADH) and also by drugs such as thiazides and inappropriate infusion of hypotonic IV fluids. SIADH signifies a hypersecretion of ADH that is independent from volume depletion or hyperosmolality. It is caused by a variety of factors such as stress, infection, major surgery and trauma, pulmonary tumours, and CNS disturbances. Similarly therapeutic use of ADH analogue desmopressin can precipitate hyponatraemia.

This patient was not volume depleted or overloaded. He was also not on any diuretic treatment. A tentative diagnosis of SIADH was made on clinical grounds. What are the criteria to diagnose SIADH?

- Normal hepatic, renal, and cardiac function - Clinical euvolaemia (absence of intravascular volume depletion)
- Normal thyroid and adrenal function
- Hypotonic hyponatraemia

- Urine osmolality greater than 100 mOsm/kg, generally greater than 400-500 mOsm/kg with normal renal function

Thyroid and adrenal functions are important as hypothyroidism and hypoadrenalism both can cause hyponatraemia. In compulsive water intake there is hypotonic hyponatraemia but the urine is dilute (cf. SIADH)

What are the next line of investigations to confirm a diagnosis of SIADH in this patient?

- Serum osmolality: Helps to identify if the hyponatraemia is in a background of normotonicty, hypertonicity or hypotonicity. (Pseudohyponatraemia can occur with paraproteinaemia, dyslipidaemias)
- Urine osmolality: Helps to differentiate SIADH from compulsive water intake. In the latter situation the diluting ability of kidney is normal and produces dilute urine. However in appropriate or inappropriate hypersecretion of ADH, the urine osmolality is above 100mOsm/kg.
- Urinary Na concentration: Helps to differentiate SIADH from volume depletion. In volume depletion urinary Na is low. In SIADH the urinary Na^+ excretion is greater than 20 – 40 meq / L
- Thyroid function tests and serum cortisol levels are necessary to exclude thyroid and adrenal malfunction. Similarly, cardiac, renal and liver function tests should prove that these organ systems are not impaired.

In this patient, renal function and liver function tests were normal. Thyroid function tests and adrenal function tests were also normal. In addition, the serum osmolality was 240 mOsm/kg, Urine Na^+ 50 meq/l and Urine osmolality 150 mOsm/kg. Does this confirm a diagnosis of SIADH?

Yes – low serum osmolality, high urinary osmolality, and increased urinary sodium excretion.

What additional tests would you require at this stage?

CT brain (with IV contrast), and CXR followed by CT chest to find out a cause for SIADH.

How would you treat this patient?

Treatment depends on the speed at which the hyponatraemia developed, volume status of the patient and magnitude and symptomatology of patient. In this patient it had developed over days and weeks judging from the history. In such a scenario, there is gradual swelling of neurons as water moves in to the cells in central nervous system. In addition there is a gradual reduction in ionized molecules in intracellular environment by reducing the ionized organic molecules. Thus due to adaptation, the effects of hyponatraemia is not drastic as anticipated by the mere plasma Na concentration. On the other hand rapid correction itself may be fatal as it interrupts this delicate balance. If the hyponatraemia has developed in less than 48 hours then more rapid correction is allowed.

In hypertonic or normotonic hyponatraemia the cause should be corrected and the hyponatraemia will correct itself automatically.

In hypotonic hyponatraemia consider the patient's volume status and degree of hyponatraemia. Infusion of isotonic saline will fill in the vascular compartment and take out the stimulation for ADH secretion.

In normovolaemic hyponatraemia that is asymptomatic or minimally symptomatic, simple water restriction will suffice. However, in situations where hyponatraemia is resistant to water restriction and where the patient is severely ill correction with hypertonic saline is necessary. Same holds true for hypervolaemic hypotonic hyponatraemia. This correction can be done with 3% saline which has 513 meq of NaCl per litre (cf. 154 meq / l in normal saline)

If the hyponatraemia developed in less than 48 hours a rate of rise of 1-2 meq/l/h for 3-4 hours until the Na concentration is above 120 meq/l is acceptable. It is safe to stop correction at this level rather than making the Na concentration 'normal'.

If the hyponatraemia was chronic in onset, target a rise of 0.5 – 1 meq/l/h of Na not exceeding 12 meq / l /d. Serum Na assessments should be frequent as one in every four hours

What are the complications of rapid corrections of Na?

Central pontine myelinosis: can present as pseudobulbar palsy, mutism and spastic quadriparesis. The patient will improve with rise in Na and then gradually deteriorate over the coming days.

This patient had a severe symptomatic hyponatraemia due to SIADH (hypotonic normovolaemic hyponatraemia) that was chronic in onset. Fluid was restricted to 1L/day but the response was poor. Demeclocycline was used as it antagonizes the action of ADH. Still the response was poor. Finally correction with 3 % saline was done over 48 hours and the patient gradually improved. However the inward chest x ray showed a right side effusion and a CT chest done later revealed a primary tumour of R/S lung.

Notes on Hypernatraemia

Hypernatraemia is defined as a Na concentration greater than 143 meq/l with levels above 155 meq/l described as severe hypernatraemia. Again a hypernatraemic patient may be euvolaemic, hypovolaemic or hypervolaemic. Hypovolaemic hypernatraemia occurs when there is free water loss exceeding salt loss. Normovolaemic hypernatraemia is more commonly encountered and examples include:

- Diabetes insipidus (cranial and nephrogenic)
- Volume loss through skin and lung in fever
- Inadequate water intake

Hypervolaemic hypernatraemia is less common but can be seen where there has been inappropriately high Na+ containing fluid infusions (use of NaHCO3 in metabolic acidosis).

Correction of hypernatraemia should also be done slowly to avoid cerebral oedema. Target a rate of correction of 1meq/l/h not exceeding 10meq/l/d. Only correct up to 135 meq/l. Before replacing fluid any causative factor for hypernatraemia should be corrected. If the patient is hypovolaemic and having low BP, give normal saline until the blood pressure improves and continue with 5% dextrose or water orally to bring down the Na level. In the normovolaemic situation, N/2 saline and 5% dextrose can be used. At the same time vasopressin or its synthetic analogue DDAVP nasal puffs can be used to retain water at distal tubules provided the renal function is normal. In a hypervolaemic situation, a loop diuretic can be used to clear sodium.

Case 10: Hyperkalaemia

Mrs. X, aged 65 years, has been having type II diabetes for 15 years. Three months ago she started having nausea, vomiting and lethargy. While investigating further, she was found to have high blood urea and creatinine values. Her Hb was 6.7 g/dl with normocytic normochromic anaemia. Ultrasound abdomen showed granular contracted kidneys with poor corticomedullary demarcation and increased cortical echogenicity. A creatinine clearance showed that she was in end stage renal failure. She was admitted to a surgical ward 2 days ago for creation of an arteriovenous fistula for chronic dialysis. Within the last 24 hours she had been complaining of palpitations and fatigue. A routine serum electrolyte report showed a potassium value of 7.1 meq/l. She was on frusemide, calcium carbonate, erythropoietin weekly injections, metformin and captopril.

How would you classify hyperkalaemia?

- Mild hyperkalaemia - Serum potassium 5.5-6.0 meq/L
- Moderate hyperkalaemia - Serum potassium 6.1 - 7.0 meq/L
- Severe hyperkalaemia - Serum potassium > 7.0 meq/L

(Normokalaemia - Serum potassium 3.5-5.3 meq/L)

How would you explain the pathogenesis of hyperkalaemia?

Potassium is an intracellular ion. The serum K^+ ion levels, which are only a small fraction of total body K^+ is what is measured as serum K^+. Though only a small fraction of total body potassium, the serum K^+ is an important component that determines the transmembrane potential. Slight variations in K^+ level can have lethal consequences. The $Na^+ - K^+$ ATPase pumps in the cell wall, keeps pushing Na^+ out to take in K^+. In hyperkalaemia, the muscle and nerve tissue has a reduced threshold for excitation. However repetitive stimulation itself can render the muscle unexcitable. The most lethal effect of hyperkalaemia is when it

affects the heart muscles. Depolarization of cardiac tissue will result in ventricular fibrillation or asystole.

The aetiology of hyperkalaemia is manifold;

1) failure to clear extracellular K^+
    a. Renal failure
    b. Potassium sparing diuretics and drugs
    c. Addison's disease
    d. Obstructive uropathy
2) Addition of K^+ to extracellular compartment
    a. Supplementation of K^+ by either IV or oral route
    b. Massive haemolysis, blood transfusions, burns
    c. Rhabdomyolysis
3) Movement of K^+ from intracellular to extracellular compartment
    a. Acidosis
    b. Digitalis toxicity and beta blocker overdose

4) Pseudohyperkalaemia
    a. Haemolysis of blood sample
    b. Lab errors

What are the risk factors for this patient to develop hyperkalaemia?

- Chronic renal failure and inability to excrete a potassium load
- Metformin can cause metabolic acidosis that results in hyperkalaemia
- Poor compliance with diabetes medication and chronic insulin deficiency
- Captopril which is an ACE inhibitor retains K^+ and loses Na^+.

What are your priorities after being informed of a serum potassium value of 7.1 meq/l?

This is a medical emergency that warrants immediate action. Severe hyperkalaemia can result in cardiac arrest. First the patient needs to be assessed with regard to ABC. All drugs that

can contribute to hyperkalaemia have to be omitted. An urgent ECG should be requested and if the ECG shows changes due to hyperkalaemia, give IV calcium gluconate (10%), 10ml stat. Calcium gluconate does not reduce extracellular K^+ levels, but it electrically stabilizes the cardiac muscle membrane preventing the risk of arrhythmias. K^+ can be temporarily pushed in to the cells by using IV Insulin that increases the amount of $Na^+ - K^+$ ATPase pumps in cell membranes. It is given as IV insulin 10u in 50% dextrose 50ml over 15 mins (dextrose is given to prevent hypoglycaemia).
IV insulin/dextrose is only a temporary measure that pushes K^+ inside cells. It should not be continued indefinitely as it does not reduce the total body potassium. Potassium binding resins can be given orally to reduce total body Potassium. However its action takes time and in between insulin dextrose infusions and nebulization with salbutamol (β-agonists also reduce extracellular K^+ by pushing K^+ into cells) can be continued if K^+ is persistently high as shown by repeated serum electrolyte estimates.
If the serum potassium is rising despite emergency measures she will need a haemodialysis as a life saving procedure. It is always important to repeat such electrolyte readings to exclude sampling errors (haemolysis of blood sample).

What are the clinical features of hyperkalaemia?

Hyperkalaemia is usually asymptomatic until cardiac arrest occurs. It should always be suspected by clinical features of underlying illness. However hyperkalaemia itself may cause symptoms such as paresthesiae, paralysis, fatigue and palpitations.

What are the other tests you would request in this patient?

- Blood urea and creatinine
- ABG
- Serum Calcium levels
- ECG

Hyperkalaemia may indicate the need for dialysis. Uraemia and acidosis are other indications for a dialysis. Serum calcium levels are assessed as hypocalcaemia can worsen the hyperkalaemia

What are the ECG features of hyperkalaemia?

ECG features change as hyperkalaemia progresses. First there will be tall tented T waves which will be followed by flattening of P waves and broadening of QRS complexes. Finally the T and QRS complexes will 'merge' together in a sine wave pattern. This precedes cardiac arrest.

Notes on hypokalaemia

Hypokalaemia is defined as a serum K^+ level below 3.5 meq/l. It is just as dangerous as hyperkalaemia with increased vulnerability to arrhythmias. Reduced extracellular potassium makes the cardiac tissue less excitable. A K^+ level below 3meq/l is associated with a significant risk of arrhythmias. The effects of hypokalaemia are seen in all excitable tissue and manifestations include, fatigue, myalgia, muscular weakness of lower limbs. With severe K^+ depletion, there may be ascending paralysis which might involve respiratory muscles. Smooth muscle dysfunction causes paralytic ileus. A potassium level below 2meq/l is associated with muscle necrosis.

There are several causes for hypokalaemia, which can be broadly categorized as;

- Reduced dietary intake
- Redistribution of potassium between intracellular and extracellular compartments
    - Metabolic alkalosis
    - Effects of drugs such as insulin and salbutamol
    - Anabolic states
    - Total parenteral nutrition
- Increased loss of Potassium from GI tract of Kidneys
    - GI tract losses – Chronic diarrhea from villous adenoma
    - Renal losses: Hyperaldosteronism, diuretics,renal tubular acidosis (type 2)

- Other causes: Hypokalaemic periodic paralysis, hypothermia, barium toxicity, hypomagnesaemia

ECG changes in hypokalaemia include flattening or inversion of T waves, ST depression and appearance of U waves after T waves. With severe hypokalaemia there may also be broadening of QRS complex and prolongation of PR interval.
One crucial factor to remember when treating hypokalaemia is that most of the K^+ is intracellular and what we measure is extracellular K^+. Therefore a change of 1 meq/l of extracellular K will correspond to a 200 – 400 meq change in total body potassium.
IV potassium supplements are dangerous as they can easily precipitate hyperkalaemia. Wherever possible it is advisable to try oral replacement first. Oral KCl tablets can be given as 2 tablets once or twice daily in moderate hypokalaemia (1 tablet has 12mmol of potassium). In symptomatic severe hypokalaemia or with ventricular arrhythmias IV KCl is necessary. It is advisable to keep the infusion rate under 20 mmol/h. IV potassium is preferably given via a central line as extravasation can be hazardous. Infuse 40 mmol first and recheck potassium. Up to 60 mmol can be given at a time via a central line. Always have continuous cardiac monitoring while giving IV potassium. The target level of correction is 4.0 – 4.5 meq/l.
It is important to correct the cause for hypokalaemia rather than correcting hypokalaemia itself. Hypomagnesaemia can coexist with hypokalaemia, and needs to be investigated and corrected.

Case 11: Adrenal crisis

Miss D, 36 year old female was admitted with a sudden collapse following a viral flu. She had complained of weakness and lethargy over the last few days. Immediately before collapsing she had complained of severe abdominal pain and had a bout of vomiting. On admission her blood pressure was 60/40mmHg, and the pulse was weak and rapid. CBS was 56mg/dl. On further questioning it was revealed that the patient had been taking 8 tablets of prednisolone daily without a prescription for joint pains. Recently, she had decided to go off the drugs as she was feeling well. The attending doctor requested an urgent serum electrolyte report.

What do you expect to find in the serum electrolyte report?

Moderate hyperkalaemia, normal or decreased sodium

What is your most likely diagnosis?

Adrenal insufficiency resulting in Addisonian crisis

What are the other possible differential diagnoses?

- Anorexia nervosa
- Acute abdomen
- Pregnancy related complications

What are your priorities on clinical suspicion of the disease?

It should be treated promptly without waiting for laboratory confirmation. Still, blood can be taken for essential investigations prior to treatment.

What are the problems this patient might have?

- Hypoglycaemia
- Electrolyte imbalance
- Circulatory collapse
- Ongoing infection

How will you treat the patient?

- Establish IV access with two wide bore cannulae
- Take blood at time of insertion of cannulae for FBC, BU/SE, blood culture, RBS
- Take 10ml of blood in a heparinized tube for later analysis of cortisol levels
- Order urine full report, urine culture, inward CXR and an ECG as other investigations
- Correct hypoglycaemia with 50% dextrose 50 ml IV and repeat if necessary
- Correct fluid deficit by
    - Correcting deficit
    - Replacing ongoing losses
    - Providing maintenance requirement until the patient takes orally

  As the blood pressure is below 90mmHg in this patient, she needs one unit of colloids infused fast. If the blood pressure is still low, 20ml/kg boluses can be given until it picks up. If facilities are available, fluid replacement is best guided by insertion of a CVP line. When blood pressure is above 90 mmHg further fluids can be given at a rate of 500 ml every 4 to 6 hours judged by the clinical signs of overload or deficit.
- Replace ongoing losses: Ongoing losses as vomiting and diarrhea has to be replaced with normal saline or as oral fluids if the patient is taking orally
- Maintenance fluid requirement: Maintenance requirement also needs to be supplemented intravenously if the patient is not taking orally.
- Replacement of corticosteroids: Hydrocortisone IV is the drug of choice as it has both glucocorticoid and mineralocorticoid activities. It should be given as IV hydrocortisone 100mg stat and as an infusion of 100mg, 8 hourly for 24– 48 hours. Then convert to 50mg 8 hourly for 48 hours and later 30mg total dose PO per day. (20mg mane and 10mg vesper). Fludrocortisone can be added 50–300 µg PO daily

- Assess need for antibiotics. The patient may have infection. Look for features of infection, and start appropriate antibiotics, usually broad spectrum IV antibiotics until culture results are available.

What are the possible causes for adrenal insufficiency in this patient?

The most apparent cause is sudden withdrawal of steroid therapy
Other causes to consider are,

- Autoimmune (polyglandular autoimmune diseases, antibodies against adrenal cortex)
- Neoplastic conditions (primary, metastatic)
- Infective conditions (tuberculosis, meningococcal sepsis)
- Metabolic disorders (amyloidosis)
- Vascular events (infarction, haemorrhage)

How will you localize the problem in the hypothalamo-pituitary-adrenal axis?

The defect can either be in the adrenal gland (primary) or in pituitary gland (secondary).
First establish adrenal insufficiency by doing a morning cortisol level at 9.00 a.m. Values less than 3µg/dl confirm the diagnosis while values above 19ug/dl exclude the diagnosis.
If it is inconclusive, three tests are used to confirm adrenal insufficiency;

A) Short synacthen test (measuring serum cortisol after synthetic corticotrophin dose, serum cortisol is measured after 30 and 60 minutes and values below 13ug/dl are diagnostic of adrenal insufficiency)
B) Metyrapone test (read)
C) Insulin tolerance test (read)

Once adrenal insufficiency is established further tests are needed to find the site of malfunction in hypothalamo- pituitary – adrenal axis.

A) A serum ACTH level > 100 pg/ml is diagnostic of primary adrenal insufficiency

B) Long synacthen test to confirm primary adrenal insufficiency in inconclusive situations
C) CRH test to diagnose secondary (pituitary) from tertiary (hypothalamic) adrenal insufficiency
D) CT / MRI, tissue culture and histological diagnosis would be useful in finding an aetiology for adrenal insufficiency.

What advice would you give this patient on discharge?

- Explain regarding the aetiology of the condition
- Advice regarding the importance of not stopping steroids suddenly. Give a time plan on tailing off of steroids
- No dietary restrictions, increase salt intake
- No activity restrictions
- Avoid unnecessary medication

Case 12: Diabetic ketoacidosis

Miss V, 24 year old female was admitted to local hospital complaining of severe generalized abdominal pain. On admission she was dehydrated with rapid deep breathing. She was underweight (body weight: 40kg) and looked malnourished. She has been taking insulin since age of 6 for type I diabetes mellitus. Over the last week she was feeling 'unwell' and had decided to cut down on her insulin dose.

What is the most likely diagnosis?

Diabetic ketoacidosis (DKA)

What is the pathophysiology of DKA?

Insulin, together with its counter-regulatory hormones (adrenaline, glucagon, cortisol, growth hormone) plays a vital role in the intermediary metabolism. Insulin is the hormone of 'abundance' which is involved in converting basic nutrients into macromolecular storage forms (glucose to glycogen. amino acids to proteins). In starvation, insulin secretion is inhibited and these macromolecules are broken down. In diabetic state where insulin production is nil, the response is like that in starvation. The unchecked activity of glucagon and adrenaline increase gluconeogenesis and glycolysis, resulting in hyperglycaemia which further impair glucose uptake in peripheral tissues. There is a rapid filtration of glucose at glomeruli that might exceed its renal threshold for reabsorption. As a result glucose is lost in urine and to excrete this osmotic load, extra water is lost from the body alongside other electrolytes. The entire process ends up in osmotic diuresis where there is loss of important ions such as sodium, potassium and magnesium. Vomiting and hyperventilation add further to the burden of maintaining homeostasis.

In the absence of insulin, circulating level of fatty acids is increased (lipolytic activity of growth hormone and cortisol is unchecked). The rise of fatty acid levels result in increased

oxygenation in the liver and/or increased ketogenesis. The acidosis can lead to circulatory collapse and death.

What are the major 'ketone bodies' you might find in this woman's blood stream?

- β – hydroxybuteric acid
- Acetoacetate
- Acetone

What are the symptoms you are going to look for in thispatient?

- Evidence of hyperglycaemia: polyuria, polydipsia, weight loss
- Evidence of acidosis, dehydration and electrolyte imbalances: abdominal pain, shortness of breath, confusion and coma, vomiting
- Evidence of a recent infection that may be the precipitating factor

What are the things you are going to look for in the examination?

- Do a quick assessment of A, B, C and need for resuscitation
- Assess degree of dehydration

Signs	**Mild (4% of body weight)**	**Moderate (6 %)**	**Severe (10%)**
Tissue turgor	Normal	reduced	Absent
Pulse	Normal	Rapid	Rapid thready
Blood pressure	Normal	Reduced	Greatly reduced
Eyes	Not sunken	Sunken	Grossly sunken
Appearance	Thirsty, alert	Lethargic	Drowsy

- Look for: Ketotic breath, Kussmaul breathing (deep sighing respiration due to acidosis)

- Cardiovascular:
    - Blood pressure is maintained until the patient rapidly deteriorates
    - Tachycardia
- Abdomen
    - Non specific abdominal tenderness
- CNS
    - Impaired level of consciousness or coma
- Other
    - Evidence for an infection (crepitations in lungs, suprapubic tenderness in UTI)

What are your differential diagnoses for this patient?

Surgical

- Any cause of acute abdomen (cholecystitis, severe peptic ulcer disease, ureteric colic)

Medical

Hyperosmolar non ketotic coma

- Pneumonia
- Porphyria
- Leptospirosis

Gynaecological

- Ruptured ovarian cyst
- Ectopic pregnancy etc.

What are the most important investigations to order at this stage?

- Arterial blood gas – To establish metabolic acidosis and its severity
- Serum electrolytes with chloride levels – to establish base line potassium levels and to calculate anion gap
- Random blood sugar – Very high in DKA

What are the other investigations you would order in this patient?

- Full blood count: to assess Hb level, evidence for an infection
- ECG: might give a clue to extremes of serum Potassium levels
- UFR, urine culture, blood culture
- Urine for ketone bodies
- Chest X ray
- Any other investigations to exclude the differential diagnoses (Ultrasound abdomen, serum amylase or abdominal X rays)

What are the issues that need immediate attention in this patient?

- Dehydration
- Insulin deficiency
- Acidosis
- Electrolyte imbalances
- Underlying infection

How will you treat her?

Correction of volume status

A) correct deficit
B) replace ongoing losses
C) give maintenance fluid requirement

Establish IV access with two large gauge cannulae and consider catheterization
Maintain an input and output chart
If the patient is in shock give 20ml / kg boluses of normal saline until the BP is picks up.
Assess degree of dehydration and calculate as a percentage of body weight to get a rough idea of volume that needs to be replaced. (1% of body weight is roughly 10ml/kg)
The resuscitation should be with normal saline (0.9% NaCl)

Using fixed regimes of fluid replacement in ketoacidosis is not recommended. Fluid replacement has to be done with close supervision of volume status clinically to detect improvement or overload
Initially if the patient is severely dehydrated, rapid replacement of fluid is necessary. Once the patient is stable replace the rest of volume (remainder of deficit + maintenance) over 24 – 48 hours
Maintenance fluid requirement: Previous days urine output + insensible loss (Or 1.5 – 2 ml / kg / hr as two units in normal saline and rest with 5 % dextrose)
If the patient is having cerebral oedema, replace two thirds of maintenance over 24 – 48 hours. Use normal saline alone.
In other situations 5% dextrose can be used for replacement as the CBS values drop with insulin replacement.
Ongoing losses need be replaced (vomitus, diarrhoea) with normal saline with added potassium (see below)

Correct insulin deficiency
The best method of replacing insulin is by a slow IV infusion with an infusion pump (less risk of sudden hypoglycaemia and hypokalaemia). The risk of cerebral oedema is high in those who receive insulin replacement in first hour of treatment. Therefore defer insulin replacement at least 1 hour from the initiation of fluid replacement.
Dose: Soluble insulin 0.05 – 0.1U/hr/kg (in this patient – 4U per hour)
Monitor CBS hourly and adjust dose. The fall of CBS should not be more than 90mg / dl per hour (the rate of insulin replacement should not fall below 0.05U/kg/hr at any point).
If facilities are not available for IV infusions, hourly IM injections can be given. Continue infusions until anion gap is normalized
When the CBS values drop to 360 mg / dl (15mmol / l) change the replacement fluid to 5 % dextrose unless contraindicated.
Insulin infusions should continue until the patient is taking orally and until 1 hour after the first subcutaneous dose of insulin

Correct electrolyte imbalances

- Potassium: Do not replace potassium in first hour of treatment. Extra cellular K^+ may actually be high due to acidosis. Invariably there is a total body deficit of K^+ in DKA and with insulin therapy K^+ will be driven in to cells resulting in hypokalaemia. Replacement dose (ideally via a central line): a maximum of 20 meq of KCl per unit of IV fluids over 2 hours slowly.

Serum K (mEq/l)	**Replacement dose**
< 2.5	Needs replacement as a separate infusion 1meq/ kg of body weight
2.5 – 3.5	40 mEq /l
3.5 – 4.5	30 mEq /l
4.5 – 5.0	20 mEq /l
Above 5.0	10 mEq /l (optional)

- Magnesium and Calcium: With diuresis there is a loss of these electrolytes. However, on most occasions they do not need replacement
- Bicarbonate: Usually there is no necessity to give bicarbonate. The acidosis will correct itself as the insulin deficiency and fluid deficiency is corrected. Bicarbonate is only indicated when severe acidosis is present, with myocardial depression.

Monitoring the patient

- Maintain input and output charts
- CBS hourly
- Serum electrolytes 2 hourly in acute phase
- Clinical monitoring (pulse rate, respiratory rate, blood pressure at regular intervals)

How will you convert the patient to her usual regimen?

Once the blood sugar is under control with insulin infusion and when the patient is well rehydrated, she is fit to resume her normal diet. At this time she will be converted to a regular subcutaneous dose of soluble insulin. Insulin infusion should continue until one hour after the first SC insulin dose. The patient

should be then converted back to her usual regimen on discharge.

What are the issues you need to address regarding her long term management?

- Identify causes for non compliance and correct it
- Address misconceptions about dosing of insulin in illness
- Advice against going 'off' insulin to lose weight
- Social issues such as family, relationship problems
- Psychological impact of being branded as insulin dependent
- Practical difficulties in taking insulin at workplace, school
- Clinical issues such as frequent hypoglycaemia that might need dose reduction

Health education

Educate the patient about diabetes and its complications, the role of insulin in metabolism, injection techniques, how to adjust and change doses in illness, pregnancy and physical exertion. Give dietary advice.

Screening for complications

Regular clinic follow up, eye screening annually, renal screening every six months, Hb_{1AC} levels every 3 months, monitoring of blood pressure, foot care.

Case 13: Thyrotoxicosis

Mrs G, 64 year old woman presented to surgical clinic with a diffuse swelling of neck. She complained of increased appetite with weight loss despite increased food intake. She also complained of heat intolerance and tremors of hand. She was diagnosed to have thyrotoxicosis and was scheduled to undergo surgery. While in ward, on the day before surgery, she developed a high fever and an altered level of consciousness. She had vomiting and profuse diarrhoea. On examination the skin was warm and moist. The pulse rate was 120 / min and respiratory rate was 34/min. Blood pressure was stable around 110/80 mmHg. Movements were retarded by muscle weakness. Within 12 hours she developed a status epilepticus and slipped in to a coma. BP dropped to 90 /60 mmHg. Pulse was irreguraly irregular. GCS was 3 / 15.

What is the most probable diagnosis?

Thyrotoxic crisis

What factors can precipitate a crisis in a patient with thyrotoxicosis?

- Surgery
- Trauma
- Uncontrolled Diabetes
- Infection
- In pregnancy; labour and ecclampsia

What are the other features of a crisis (not seen in this patient)?

- Jaundice
- Hypercalcaemia

What are the principles of management of this patient?

- Treating life threatening complications
- Blocking synthesis of thyroxin
- Preventing peripheral action of thyroxine
- Treating the underlying cause
- Supportive measures

What are the investigations you would order?

- Thyroid function tests
- FBC, BU, Serum electrolytes
- FBS
- FBC
- Blood culture
- CXR
- ECG
- Arterial blood gas analysis

How will you treat this patient?

Manage life threatening complications

- The arrhythmia, drop in blood pressure indicate onset of heart failure which has a high mortality in these patients.
- She should be propped up and attached to a cardiac monitor. Supplemental Oxygen should be given via a face mask.
- (See case report on heart failure)
- Rhythm conversion by cardioversion may not be successful as long as thyrotoxic state persists
- Ventricular rate can be controlled with digoxin (First IV and then maintenance dose orally)

Reducing synthesis and blocking release of thyroxine

- Propylthiouracil: 1g loading dose via NG and 200 – 300mg 4-6 hourly
- Iodine: Given at least 1 hour after propylthiouracil to prevent exacerbation of crises by additional thyroxine production. It can be given as Lugol's Iodine (16 mg bd PO), Potassium Iodide (50 mg bd PO) or Sodium Iodide

(0.5 mg bd IVI). Lithium carbonate is an alternative if the patient is allergic to thyroxine.

Reducing peripheral action of thyroxine

- Propanolol is the drug of choice, as it also blocks peripheral conversion of T4 to T3. Give IV propanolol 4 - 6 hourly in 0.5 mg increments (titrating against heart rate) up to a total dose of 10mg
- Diltiazem or guanethidine can be used when propanolol is contraindicated.

Treat the underlying cause if possible

- Surgery in the case of a toxic nodular goiter or solitary toxic adenoma (after stabilization)
- Long term antithyroid drugs in case of Grave's disease
- Radio-iodine

Supportive therapy

- NG feeds
- Steroid replacement for transient hypoadrenalism due to excess rate of corticosteroid metabolism. (hydrocortisone 300mg stat and 100mg 8 hourly)
- Thiamine replacement
- Sedation
- Chlorpromazine 25-50 mg 4-6 hrly to prevent shivering
- Maintain a positive fluid balance
- Anticoagulation if in atrial fibrillation or if pulmonary embolism is suspected

Case 14: Acute renal failure

Mrs. P, aged 35 years, developed a fever that was progressively worsening. She was having severe arthralgia, myalgia, retro-orbital headache and soon became icteric. On admission to local hospital, she was clinically diagnosed to have leptospirosis. Her level of consciousness deteriorated progressively and the urine output on two consecutive days was 300ml and 150ml for 24 hours. Her blood urea was 315 mg/dl and serum creatinine was 12.6 mg/dl. She was immediately transferred to a tertiary care center.

What is the complication she has developed?

Acute renal failure

What is acute renal failure?

Deterioration of renal function over days to weeks is termed acute renal failure

What are the types of acute renal failure?

- Pre renal uraemia – This refers to reduction in urine output due to lack of perfusion of kidneys. It is frequently seen in hypovolaemic, septic and cardiogenic shock
- Intrinsic 'renal' uraemia – In intrinsic renal failure the glomeruli, vasculature, tubules or the interstitial tissues are diseased. If left untreated, pre renal failure can easily progress to intrinsic renal failure
- Post renal uraemia – In this category, the renal function deteriorates as a result of obstruction to urine flow from pelvicalyceal system downwards. With early detection, obstruction can be relieved and the renal function salvaged.

Give examples for each type

Pre-renal

- Any cause of significant hypovolaemia (Burns, haemorrhage, and sepsis)

Renal

- Sepsis
- Contrast nephropathy
- Nephrotoxic drugs
- Infective causes
- Snakebites
- Trauma and rhabdomyolysis
- Glomerulonephritis

Post renal

- Obstructive uropathy

If this patient's urine output was very low for consecutive hours and if you are the attending doctor how would you differentiate the types of renal failure?

The idea here is to differentiate between pre-renal and intrinsic renal failure. There are several ways of doing that.

- Clinical presentation – If the patient is showing evidence of dehydration and shock (history of diarrhea, vomiting, tachycardia, cold clammy extremities, low pulse volume, low jugular venous pressure) pre renal failure is more likely. On the other hand if there is high serum creatinine with fluid overload or normovolaemia, then intrinsic renal failure is a possibility
- Biochemical indices – if available, following tests would give a clue to diagnosis. The rationale of these indices is that if the problem is pre renal, the renal glomeruli and tubules are still working. Therefore it will conserve solutes with maximum efficiency given the low GFR. While in intrinsic renal failure though the GFR is low, the concentrating ability of kidney of solutes is also lost resulting in more salt wasting in urine

Test	Pre renal failure	Intrinsic renal failure
Urine sodium (mmol / l)	< 10	>20
Urine Cr / Plasma Cr	>40	<20
Urine specific gravity	>1.020	1.010
Urine osmolality	> 500	Close to plasma osmolality
Fractional excretion of Na*	**<1**	**>1**

* Na clearance / Cr clearance

- Response to therapeutic interventions – pre renal failure will respond to a fluid challenge (200 ml of IV fluids over 20 minutes and repeated if necessary) and the urine output will pick up. Still in intrinsic renal failure, it will worsen fluid overload

How would you know that the rise in serum creatinine is not due to chronic renal failure?

History–obviously in this scenario the history has a clear aetiology for acute renal failure, but in many other instances the distinction is not so clear cut. In fact Mrs. P might have had undetected chronic renal failure that was exacerbated by the acute event

Radiological evidence–Ultrasonically assessed kidney size will help to differentiate a chronic process from an acute one. A chronically diseased kidney is small in size with increased cortical echogenicity while in acute renal failure the kidney may be swollen with loss of corticomedullary demarcation

Skeletal survey–Renal osteodystrophy and its radiological changes such as rugger jersey spine, osteoporosis, and cystic fibrosis of marrow is seen in chronic renal failure

Haematological evidence–Anaemia of chronic disease

What are the investigations you would request for Mrs. P?

Investigations are done for two reasons

1. To assess current metabolic picture and possible complications
2. To find an aetiology for ARF

Assessing metabolic status and possible complications

- Blood urea, serum creatinine, serum electrolytes – To assess renal function
- Arterial blood gas – To detect metabolic acidosis
- Full blood count and if it is abnormal proceed with a clotting screen
- CXR – To detect fluid overload and pulmonary oedema
- ECG – Possibility of effusions, hyperkalaemia
- Ultrasound scan KUB (kidney, ureter, bladder)

In this case scenario the cause is obvious for the renal failure (leptospirosis). However in other situations different investigations (ESR, CRP, ANA, dsDNA, blood and urine cultures) would be necessary to find a cause

Mrs. P suddenly became breathless in night. There were bilateral crepitations in lung bases. The oxygen saturation dropped. What was the complication she had developed?

Pulmonary oedema

How would you manage this situation?

- Prop up
- Oxygen via face mask (2-4 L / min)
- IV morphine 2.5 – 5 mg
- IV frusemide 40 – 80 mg (at a rate not exceeding 4mg / min)
- Nitrate infusion if not responding
- Nebulization with salbutamol can help

What is the other life threatening complication this patient can develop?

Hyperkalaemia

If you are the house officer of the tertiary care institute she is transferred for dialysis, how would you manage this patient?

- Exclude / confirm life threatening emergencies and correct them (pulmonary oedema and hyperkalaemia)
- Look for correctable factors to avoid intrinsic renal failure (hypovolaemia, hypotension, sepsis, post renal uraemia, accelerated hypertension)
- Do necessary investigations to assess metabolic status and also to arrive at a cause for ARF
- Fluid balance – Maintain input output charts and restrict daily intake into previous day's urine output + insensible losses. The fluid status should be frequently assessed (ideally with help of a CVP line)
- Diet – protein content is restricted to 20 – 40 g / d, Sodium and potassium to less than 50mmol / d. Energy content should be at its usual level (around 2000 Kcal/ d)
- Treat the cause for renal failure. (antibiotics for leptospirosis)
- Do daily serum electrolytes, urea, and serum creatinine
- Avoid nephrotoxic drugs
- Decide on renal replacement therapy as appropriate

What are the indications for renal replacement therapy?

- Uraemia
- Fluid overload
- Hyperkalaemia
- Acidosis

What are the methods available for renal replacement therapy?

- Haemodialysis
- Haemodiafiltration

What do you think is the best option for this lady? Intermittent haemodialysis or continuous venovenous haemodiafiltration?

Theoretically a continuous method of renal replacement therapy seems more suitable. However, trials to-date have shown no benefit of continuous renal replacement therapy over traditional intermittent haemodialysis.

Case 15: Acute abdomen

Mr J, a 55 year old male presented with sudden onset, severe epigastric pain. He has been having on and off pain in the same area for several weeks and the onset of symptoms was related to meals. This time the pain was excruciating and radiating to back. It was constant in nature, not relieved by bending forward and also did not respond to standard analgesics. On examination, the patient was in hypovolaemic shock with cold clammy extremities and absent peripheral pulses. He was afebrile but was quite ill looking. Abdomen showed intense guarding and rigidity all over. The digital examination of rectum revealed an empty rectum.

What are the possible pathologies in this patient?

- Perforated peptic ulcer
- Acute Pancreatitis
- Intestinal obstruction
- Acute cholecystitis with perforation

If you are the attending physician, how will you manage this patient?

Assess airway, breathing and circulation first. His vital signs, cardiac rhythm and Oxygen saturation has to be monitored. This patient needs immediate resuscitation. Two large bore IV cannulae should be inserted and oxygen administered via face mask (high flow Oxygen). Two liters of crystalloids need to be infused fast. If still in shock, a colloid such as hetastarch can be started. Meanwhile blood should be sent for urgent investigations.

- Full blood count
- Blood urea and electrolytes
- Blood culture
- Grouping and DT
- Arterial blood gas if indicated(to detect acidosis, hypoxia)

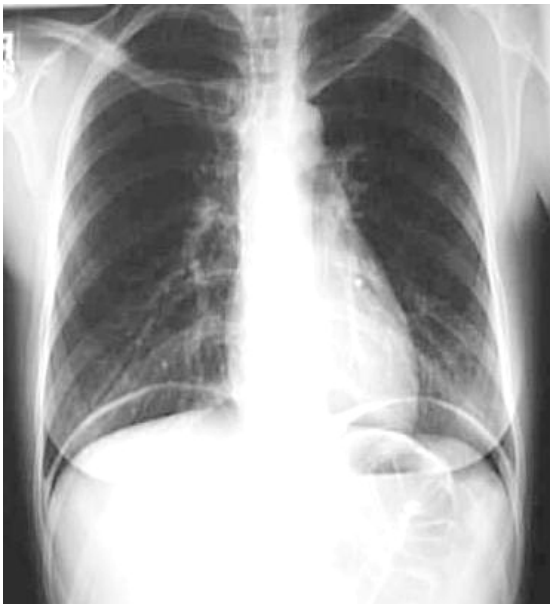
Other investigations

- ECG
- Chest x ray – erect
- Abdominal X ray supine

The acute abdomen may either be medical or surgical. Therefore it is prudent to keep patient ready for surgery.
The patient should be kept nil orally and a NG tube should be inserted if the patient is semiconscious, having signs of upper GI bleeding or abdominal distension as a result of distal obstruction. Input output charts should be maintained accurately and catheterization is indicated in this patient. Once the patient is stabilized, a detailed history taking and examination can be carried out and management adjusted accordingly.
Once the patient is stable, IV fluids can be continued at the maintenance level (1.5 – 2 ml / kg /hr). Any ongoing losses should be replaced at 1:1 ratio with normal saline. Potassium should be corrected according to serum electrolyte assessments.
Never forget pain relief. There is no reason to keep the patient in agony. Nowadays highly efficient painkillers are available and they should be used liberally to relieve pain. This patient can be given IM pethidine 1mg / kg with an antiemetic or morphine injections 5 – 7.5 mg on a 6 – 8 hourly basis. Avoid NSAIDs such as diclofenac sodium if haemorrhage is suspected.
Following resuscitation, the patient's level of consciousness improved. Blood pressure was 90 / 60 and oxygen saturation was maintained at 92%. On a detailed history it was revealed that he was on long term NSAIDs for osteoarthritis and had peptic ulcerations as confirmed by a recent endoscopy. On examination he was very pale and the abdomen was showing board like rigidity. On percussion the liver dullness was absent. The bowel sounds were diminished on auscultation.

What is the likely diagnosis?

Perforated peptic ulcer



Chest x ray (erect) showed gas under the diaphragm. An urgent surgical referral was done, theatre and anaesthetist was informed and the patient successfully underwent surgery within one hour.

In this situation, the cause for pain was surgical, what are the medical causes for an acute abdominal pain?

- Diabetic ketoacidosis
- Basal pneumonia
- Acute gastroenteritis
- Acute hepatitis of any aetiology (viral, leptospirosis)
- Rare causes such as porphyria and Lead poisoning

Do not forget obstetric and gynaecological causes in a female patient. Always exclude pregnancy related complications in a female with child bearing potential.

Case 16: Pancreatitis

Mr K, a 37 year old man presented to outpatient's department with severe abdominal pain. It was a severe epigastric pain. He felt as if it was going 'through' the body to back. The severity of the pain reduced on bending forward. Otherwise it was persistent. On history it was revealed that he has been having similar episodes on and off over the last 5 years with a frequency of one attack per year. He was a heavy alcoholic. An ultrasound scan done three months ago showed chronic cholecystitis with a contracted gall bladder and a few stones. On examination he was afebrile, not icteric or pale. The blood pressure was 110 / 80 mmHg with tenderness over the epigastric area. However given the degree of pain, guarding was conspicuously absent.

What is your diagnosis?

Acute on chronic pancreatitis

What are the features in history and examination that suggest the diagnosis?

- Severe epigastric pain
- Radiation to back with relief with bending forward
- The recurrence of attacks suggest chronic pancreatitis
- Alcoholism and gallstones are aetiological factors for pancreatitis
- The absence of guarding or rigidity despite severe pain

What is the pathophysiology of pancreatitis?

The pancreas is a solid organ with an endocrine component, exocrine component, vasculature and connective tissue. The powerful proteolytic enzymes in pancreatic juice are kept inactive until they are secreted in to the gastrointestinal tract by various mechanisms. If the enzymes are activated within the pancreas, it will result in autodigestion of pancreas. On the other hand, proteolytic enzymes such as trypsin have a catalytic effect in converting other non active proenzymes into active enzyme by

cleavage resulting in rapid activation of proteolytic enzymes. In pancreatitis these defense mechanisms fail and there is premature activation of digestive enzymes within the pancreas resulting in inflammation and destruction of pancreatic tissue. Depending on the severity of the process, it is termed oedematous, haemorrhagic or necrotic. Following acute pancreatitis exudate can collect anterior to pancreas in the lesser sac giving rise to a pseudocyst. Pancreatic abscess is another complication that is seen in more severe form of necrotic pancreatitis.

What are the causes for chronic pancreatitis?

- Chronic alcoholism
- Hypertriglyceridaemia
- Pancreatic neoplasm
- Hereditary and idiopathic pancreatitis
- Haemochromatosis
- Primary sclerosing cholangitis
- Primary biliary cirrhosis
- Surgical complications (following pancreatic resection, subtotal gastrectomy)
- Enzyme deficiencies (amylase, trypsin, enterokinase deficiency)

What are the causes for an acute episode on background of chronic pancreatitis in this patient?

Gallstones, alcohol binge, hypertriglyceridaemia, trauma, occult disease of pancreatic and biliary tree, pancreatic cancer

How will you manage this patient in acute setting?

The management of pancreatitis is essentially medical. Only a complication such as necrosis of the pancreas, abscess or pseudocyst formation will require surgical intervention.

Other possibilities such as perforated peptic ulcer should be kept in mind as differential diagnoses. And while executing the

management plan, those possibilities must be excluded. Therefore investigations and management goes hand in hand. The first step is to assess airway, breathing and circulation. Blood should be taken for basic investigations: FBC, Blood urea and electrolytes, liver function tests, serum amylase, serum calcium and blood culture. The patient should be kept nil orally and started on IV fluids. If necessary, potassium can be replaced depending on serum electrolyte values. A NG tube is inserted if intestinal obstruction or paralytic ileus is suspected. Accurate fluid balance charts should be maintained and the patient should be catheterized.
Pain relief is essential in pancreatitis and strong opioid pain relief is often necessary in a regular dosage until the episode settles (avoid morphine as it may cause spasms of sphincter of Oddi).

Do you know of any scoring systems that evaluates prognosis in acute pancreatitis?

Ranson & Glasgow scales and APACHE scores are based on clinical and laboratory parameters that are assessed on admission and a few days afterwards. The score of each system is said to have a predictive value on outcome of the episode. However assessing patients with these scoring systems is a cumbersome process.

After five days following admission, the clinical condition of the patient improved. However he continued to complain about an upper abdominal fullness and on palpation an ill defined mass was felt in the epigastrium. He was afebrile. What is the most likely complication he has developed?

Pseudocyst of the pancreas

A CT scan confirmed the diagnosis. He was transferred to a surgical ward for cystgastrostomy. He recovered without further complications.

What are the other complications he can develop during the acute episode?

Local: necrosis, abscess formation, ascites, massive intraperitoneal haemorrhage, thrombosis of blood vessels running adjacent to pancreas

Systemic: Serious complications can occur involving almost all organ systems of the body. This is why patients with acute pancreatitis needs close monitoring

- Cardiovascular: sudden cardiac death, pericardial effusion, hypovolaemia
- Respiratory: pleural effusion, adult respiratory distress syndrome, atelectasis
- Acute renal failure
- Gastrointestinal: GI haemorrhages, obstructive jaundice
- Haematological: disseminated intravascular coagulation
- Metabolic: hyperglycaemia, hypertriglyceridaemia,
- Hypocalcaemia, fat necrosis

What are your concerns regarding the further management of this patient?

- Features of exocrine and endocrine deficiency: diabetes mellitus, malabsorption syndrome with wasting and diarrhea.
- Chronic pain
- Vit B_{12} malabsorption
- Patient is vulnerable to all complications of acute pancreatitis with recurring episodes.
- Chronic obstruction of biliary tree
- High risk of GI bleeds

How will you diagnose chronic pancreatitis in this patient?

Typical episodes of pain on background of chronic pancreatic insufficiency (impaired glucose tolerance, malabsorption) is quite suggestive of the diagnosis. Examination may not reveal much in between attacks. Abdominal X rays characteristically show scattered calcification in the area of pancreas. However it is

not a universal finding. A CT scan will show localized pancreatic duct dilatations. In doubtful situations ERCP will help to delineate the pancreatic duct abnormalities

This patient has impaired glucose tolerance, malabsorption and chronic pain syndrome. How will you manage these problems?

The patient has developed diabetes due to damage to the pancreatic islet cells. Therefore he is likely to be dependent on exogenous insulin. An insulin regimen suitable for patient's needs has to be started and continued. The patient has to be reviewed with fasting and post prandial blood sugar values until control is achieved.
The exocrine enzymes have to be replaced from outside. They are available as ingestible formulations but are quite expensive.
Chronic pain syndrome is the most distressing component in management. It is resistant to standard analgesics. Stepwise increments in doses and types of analgesia are recommended to achieve best control of pain (WHO pain management ladder). Coeliac plexus block or partial/total pancreatectomy are considered as last options.

Case 17: Upper gastrointestinal haemorrhage

Mrs L, a 65 year old female was admitted to medical casualty with upper abdominal pain. There was no history of infection or vomiting. She was pale, pulse was 80/min and the blood pressure was stable. There was also some epigastric tenderness. She has had dyspeptic symptoms for last 6 years and was followed up for osteoarthritis at a rheumatology clinic. On day three, the bystander had noticed coffee ground vomitus. Careful history taking revealed that she had had malaena for the last 24 hours. At this time she was very pale with tachycardia. The blood pressure had dropped to 90/60mmHg. Extremities were cold and she was short of breath. IV omeprazole was started, blood was sent for grouping and DT and other investigations. Two hours later she had another bout of vomiting and went into cardiac arrest. She could not be resuscitated.

What is the likely cause of death?

Massive upper GI bleed

What are the causes of upper GI bleeding?

The common causes are

- Peptic ulcer
- Mallory Weiss tear
- Oesophagal varices
- Erosive gastritis

Less common causes are

- Neoplasms of stomach oesophagus and duodenum
- Aorto – intestinal fistulae
- Angiodysplasia

What are the clinical features of an upper GI bleed?

- Haematemesis
- Malaena

- Features of hypovolaemia such as; tachycardia, tachypnoea, weak pulse, reduced capillary refill etc.

What is the reason for coffee ground vomitus in this lady?

Blood exposed to acidity of gastric juice turns dark as a result of haemoglobin reacting with HCl acid. The resultant altered blood can be either vomited or passed per rectum.

Could she have presented with a fresh bleed per rectum?

Yes, but it is extremely unlikely. Passing fresh blood per rectum is called haematochezia. It is usually seen in lower GI bleeds. However massive bleeding from upper GI tract in instances such as aorto duodenal fistulae will produce haematochezia rather than malena as there is less time for interaction with hydrochloric acid

What are the principals in managing an acute GI bleed?

- Resuscitation
- Diagnosis of the cause
- Treating the cause

Resuscitation

- Airway and breathing – Make sure that blood and vomitus is not obstructing the airway. Place the patient in lateral position if there is a risk of aspiration and suck out the secretions
- Circulation- Make a rough estimate of the amount of blood loss.
- (See case discussion on hypovolaemic shock)
- Insert two large bore cannulae
- Infuse crystalloids first, and after 2l, reassess
- If still showing evidence of hypovolaemia try infusing colloids (1L)
- Send blood for grouping and DT
- Resuscitation should be goal directed
    - Hb – 8 g / dl
    - SpO2 – 95 %
    - HCT – 28 %

- Give O_2 by mask, and monitor vital parameters
- Catheterize, and insert a CVP line

Diagnosis and treatment of the cause

Diagnosis depends on a detailed history, examination and some selected investigations. Once the patient is stabilized, a history should be taken to exclude / confirm both common and rare causes of upper GI bleeding. In this lady the cause could either be erosive gastritis or peptic ulcer disease. In either situation it is best handled by a team of intensivists, GI surgeons and physicians.

What are the suitable first line investigations to make a diagnosis?

- Emergency endoscopy- This is the first line investigation of choice. However in 10 % of upper GI bleeds it can be non diagnostic. Diagnostic value of endoscopy is limited by factors such as a massive bleeding obstructing vision and a too small bleed failing to alert the examiner. The advantage of endoscopy is that it can be therapeutic as well as diagnostic.
- Mesenteric angiography- this might show a bleeder when endoscopy fails. However it needs a hemorrhagic rate of 0.5 – 1 ml / min for visibility. Angiography can also be therapeutic as embolization of the bleeder or local infusions of vasopressin can be carried out at the same time.
- MRI, CT and ultrasound scans are of limited use in this situation (cf. bleeding due to an aneurysm). The chest X ray might give a clue to exclude a differential diagnosis (gas under the diaphragm in case of a perforated viscus).
- FBC – To assess O_2 carrying capacity of blood and to exclude clotting abnormalities due to low platelet counts
- PT/INR – To exclude clotting abnormalities
- BU/SE – To assess derangement of homeostasis with massive haemorrhage and transfusions
- ECG – Previously existent cardiac conditions may worsen with blood loss

- Liver enzymes and bilirubin – To exclude secondary causes for bleeding

If the bleeding is due to erosive gastritis or peptic ulcer disease, how will you treat this lady?

- Immediate management includes resuscitation and administration of IV omeprazole.
- Bleeding might stop spontaneously.
- If bleeding continues, endoscopic under-running of the bleeder or even partial gastrectomy has to be done as an emergency surgery

Further management includes healing of ulcers and prevention of occurrence of new ulcers. The patient should be started on H_2 blockers or proton pump inhibitors. *Helicobacter pylori* eradication by triple therapy is also important.
In case of erosive gastritis all offending drugs should be stopped immediately. In this case it would be the NSAIDs. Stress, steroids and alcohol also can cause similar erosions.

If this lady gives a history of hepatitis B infection 10 years ago with HbSAg positivity plus evidence of chronic liver impairment, what would be your likely diagnosis?

Bleeding from oesophagal varices

What are the other possible causes of oesophagal varices ?

Prehepatic

- Portal vein thrombosis
- Splenic vein thrombosis

Hepatic

- Alcoholic liver disease
- Hepatocellular carcinoma
- Chronic active hepatitis
- Primary billiary cirrhosis
- Veno occlusive disease

Post hepatic

- Budd Chiari syndrome

- Constrictive pericarditis
- Tricuspid valve disease

Why is bleeding from oesophagal varices dangerous?

Unlike other causes of GI bleeding, this aetiology carries a higher mortality (50%). The mortality from a rebleed is even higher

How would you treat a massive bleed due to oesophagal varices?

- Resuscitation
- Arrest the bleeding
- Prevention of further bleeds

The principals of resuscitation is same as described earlier.

Arresting the bleeding

- Emergency endoscopy with banding and sclerotherapy are the two treatment options. It is successful in 80 % of patients. Balloon tamponade with a Sengstaken – Blakemore tube (consists of two balloons that exert pressure on lower oesophagus and gastric fundus) can be carried out if the bleeding obscures endoscopic vision. Leaving the compression for too long can have its own sequalae.
  Pharmacological methods
- Infusion of vasopressin/terlipressin/octreotide
- Vasopressin can be given as 0.4U/min until bleeding stops and is continued for another 24 hours at half the strength. It constricts splanchnic circulation but also has side effects on systemic circulation by worsening angina and ischaemic heart disease.
- Terlipressin has fewer side effects and where available, it is the drug of choice

Preventing rebleeds

Interval banding / sclerotherapy
Pharmacological agents to reduce portal pressure (propanolol)
Portosystemic shunt surgery

Case 18: Decompensated liver disease

Mr E, a 45 year old male was brought to hospital in a state of confusion. The bystanders gave a history of heavy alcohol consumption over the last 25 years. He has had several episodes of haematemesis in last 2 years with the most recent episode occurring 2 days ago. Investigations done on previous hospital admissions had led to the diagnosis of decompensated alcoholic liver disease. For the last few days the patient was awake at night and drowsy at daytime with on and off confusion. On examination, he had evidence of alcohol abuse (parotid enlargement, dupuytren's contracture) as well as icterus, pallor and ascites. His GCS was 8/15 (E-2, M-5, V-1) . Rest of the examination was normal. His drug chart had propanolol, ISMN, spironolactone and frusemide. He was also taking tramadol for a chronic backache. He was not a diabetic.

What is your diagnosis?

Hepatic encephalopathy

What are the risk factors in this patient which may have precipitated encephalopathy?

- Variceal bleeding
- Diuretics
- Possible constipation due to tramadol
- Alcohol binge

Hepatic encephalopathy with flapping tremors and icterus is an indicator of liver failure, how will you classify liver failure?

- Acute liver failure: liver failure in a previously healthy patient
- Acute on chronic liver failure: liver failure in a patient with previously diagnosed chronic liver disease

Depending on time duration between symptoms of liver failure and onset of encephalopathy it can be further classified as;

- Fulminant hepatic failure: Encephalopathy within 8 weeks of onset of liver failure symptoms
- Late onset hepatic failure: Encephalopathy within 9 – 26 weeks

This patient has acute on chronic hepatic failure with late onset disease.

This patient has a clear cause of hepatic failure; chronic alcoholic cirrhosis, what are the other causes of hepatic failure?

- Infections: leptospirosis, viral hepatitis
- Toxins: Carbon tetrachloride
- Drugs: isoniazid, paracetamol overdose
- Metabolic disorders: Wilson's disease, haemochromatosis, acute fatty liver of pregnancy, primary biliary cirrhosis, alpha 1 anti-trypsin deficiency
- Vascular: Budd-Chiari syndrome, veno-occlusive disease

What are the clinical features of acute liver impairment and encephalopathy?

- Jaundice
- Constructional apraxia
- Flapping tremors
- Fetor hepaticus

How will you grade this patient's encephalopathy?

Grade I: Altered mood and behavior
Grade II: Drowsiness, confusion and slurred speech
Grade III: Significant confusion, restlessness or stupor
Grade IV: Coma

This patient is in grade III encephalopathy

How will you manage this patient?

First exclude obstruction to airway and breathing. Make sure circulation is adequate. Exclude other causes for confusion. Do urgent random blood sugar and take blood for other investigations while establishing IV access.
Correct hypoglycaemia with 50ml of 50% dextrose and confirm with repeat RBS measurements.
Assess need for intubation and ventilation (respiratory rate <8, a drop in saturation despite supplemental oxygen, grade III, IV encephalopathy)
Send blood for urgent investigations

- Full blood count (to assess Hb level, WBC/DC to detect ongoing infection, platelet count to detect evidence of DIC)
- Blood urea and creatinine (renal and hepatic failure goes hand in hand. In hepatorenal failure, despite renal impairment, blood urea values may be misleadingly low as liver is not producing urea)
- Serum electrolytes (to exclude electrolyte abnormalities)
- Blood and urine cultures (to exclude ongoing infection)
- PT/INR (altered in acute liver disease)
- Serum proteins (albumin level is low and albumin to globulin ratio is reversed in chronic liver disease.)
- Liver profile (AST, ALT, ALP, Serum bilirubin)
- Arterial blood gas

Steps in further management

- Prop up
- Insert nasogastric tube
- Start a 10% dextrose infusion (1L 12 hourly) and check CBS 4 hourly (avoid saline as an IV fluid)
- Monitor pulse rate, respiratory rate, level of consciousness and blood pressure regularly
- Monitor saturation with pulse oxymetry and maintain saturation above 90%
- Grade III or IV encephalopathy is ideally managed in an ICU setting

- Avoid diuretics and sedatives
- Start lactulose 20ml tds or bd to induce a diarrohea to reduce intestinal nitrogen load
- Start an antibiotic to sterilize the gut. e.g – oral rifaximin or metronidazole
- IV vitamin K 10mg and folic acid 15mg /d
- Omeprazole IV infusion to avoid further bleeds by gastric ulceration
- Liaise with a gastroenterologist to decide on upper GI endoscopy

How will you advice about the patient's diet / feeds?

Low in proteins
Low in sodium

With close monitoring and above management, patient's clinical condition improved. Still he continues to have ascites which is causing shortness of breath. How will you manage this problem?

First, a diuretic such as spironolactone should be started provided the encephalopathy has resolved. The weight loss per day should be around 0.5 kg. If the response is poor, frusemide could be added, in a ratio of frusemide 40mg to spironolactone 100mg.
If ascites is resistant, paracentesis with a concurrent IV infusion of salt poor albumin should be attempted.

While being treated with diuretics, the patient developed fever and abdominal discomfort. A therapeutic aspiration revealed spontaneous bacterial peritonitis(SBP).
How do you diagnose spontaneous bacterial peritonitis?

If ascetic fluid contains more than 250 WBC per ml with more than 75% neutrophils, then SBP is likely. Antibiotics should be started empirically (with coliform and anaerobic cover) after taking cultures.

What are the other complications this patient is likely to develop?

- Multi organ failure with sepsis
- Hypoglycaemia
- DIC and coagulopathy
- Stress ulceration of stomach
- Cerebral oedema

The patient's clinical picture improved and he was discharged. What are the things you should do on discharge?

- Psychiatry referral
- Health education
- Stress on need to stop alcohol altogether

What is the long term prognosis for this patient?

Extremely poor. Decompensated liver disease with complications cannot be reversed at this stage. He will continue to deteriorate in the coming months

Case 19: Stroke

Mr S, a 56 year old male was admitted to medical casualty with sudden onset weakness of the left side of the body. He was a diagnosed patient with hypertension (for10 years), type 2 diabetes (for 8 years) and hypercholesterolaemia for same duration. He had had a similar episode involving the same side of the body two years ago, but made a full recovery in 6 days. He had been a heavy smoker. On examination, he was conscious and rational but the left arm and the leg had a power grading of two and three respectively on examination. The reflexes were diminished but there was no alteration in sensation. He understood verbal commands but was unable to talk.

This patient has had an acute stroke, What are the basic pathological types of strokes?

- Haemorrhagic strokes
- Ischaemic strokes

What are the risk factors in this patient for a stroke?

Non modifiable risk factors

- Male sex
- Advancing age
- Previous history of cerebrovascular accidents

Modifiable risk factors

- Hypertension
- Diabetes mellitus
- Smoking
- Hypercholesterolemia

What are the other risk factors for a stroke that are not mentioned in the case history?

For ischaemic strokes;

- Hyper-coagulable states, hyperhomocystenaemia
- Oral contraceptive pill

For hemorrhagic strokes;

- A bleeding tendency
- DIC, haemolytic uraemic syndrome (HUS)
- Anticoagulation (warfarin, heparin)

What is your primary concern at first contact with the patient?

A – Airway; make sure that the airway is patent, suck out secretions
B – Breathing; correct saturation, give supplementary oxygen if necessary
C – Circulation; he is unlikely to have a major hypovolaemia unless the affected areas involve the vasomotor regulatory center

What is the next step in assessment?

Take a brief history including

- Details of this episode
- Onset of symptoms: time, progression, chain of events
- Type of symptoms; weakness, paresthesiae, vertigo, blackouts, nausea and vomiting
- Medical interventions done up to now (e.g – taking aspirin)
- Details of similar episodes in past
- Assess the risk factors

On examination:
General: assess for evidence of dyslipidaemias, BMI
Cardiovascular system: pulse – rate and rhythm, blood pressure, look for murmurs (infective endocarditis, mitral stenosis), listen for renal and carotid bruits
Central nervous system:
Higher functions
Cranial nerve palsies, gaze palsies, fundi
Limbs – power, tone, reflexes, sensation, plantars, gait
Cerebellar signs
Assess other organ systems as well

Is it a stroke or a transient ischaemic event?

A transient ischaemic event is a neurological deficit that resolves within 24 hours (80% resolve in first hour). Anything persisting beyond this limit is a stroke

Is it a haemorrhagic or an ischaemic stroke?

This is a difficult question to answer on history and examination alone. However a history of anticoagulation, disorders of clotting cascade, rapid onset and non progression of symptoms may point towards a haemorrhagic stroke. Also nausea, vomiting, alteration of level of consciousness and headache is more frequently associated with haemorrhagic strokes.

What are the major vascular territories affected in strokes and what is the likely territory that is involved in this patient? (based on history and examination)

The major vascular territories are

- Middle cerebral artery territory
- Anterior cerebral artery territory
- Posterior cerebral artery territory
- Vertebrobasilar territory

Middle cerebral artery involvement can cause;

- contralateral hemiparesis
- contralateral hypoesthesia
- ipsilateral hemianopia
- Expressive or receptive aphasias if in dominant hemisphere
- Agnosia
- Weakness of arm and face > weakness of lower limbs

Anterior cerebral artery territory incidents can cause;

- Disinhibition & impaired judgment
- Unmasking of primitive reflexes
- Incontinence
- Socially inappropriate behaviour
- Gait apraxia
- Weakness of lower limbs > upper limbs

Posterior artery incidents cause;

- Cortical blindness
- Visual agnosia
- Contralateral homonymous hemianopia or blindness
- Impaired memory

Vertebrobasilar artery accidents can cause;

- Vertigo
- Dysphagia and dysarthria
- Syncope and ataxia
- Nystagmus and diplopia
- Crossed symptoms : Ipsilateral cranial nerve involvement and contralateral sensory and motor involvement

Given the clinical features in this patient, i.e.; hemiparesis (weakness of arm > weakness of leg), sparing of cranial nerves and expressive aphasia, a middle cerebral artery accident is more likely on right cerebral hemisphere

How will you investigate this patient?

A non-contrast CT scan of brain is essential to differentiate ischemic strokes from hemorrhagic strokes. An infarct may not be visible in the early phase (an apparently normal CT does not exclude an infarct). A haemorrhage will clearly show on non-contrast CT.

Biochemical investigations

- Clotting profile
- Lipid profile
- Full blood count – to exclude stroke mimics such as CNS infection
- Serum electrolytes (hyponatraemia)

Other investigations

- Doppler study of carotid arteries – to see if the patient is a candidate for carotid endarterectomy
- Electrocardiogram

- Echocardiogram to see if there are any small clots of cardiac origin. A transoesophagal echo may be a better option

This patient's CT did not show any obvious ICH. How will you treat this patient?

If there is an infarction, maintaining perfusion to the rest of the brain is very important. An acute stroke presenting within 3 hours with no contraindications for clot lyses can be treated with tissue plasmin activator (t-PA).
Other drugs and interventions for this patient include,

- Aspirin
- Atorvastatin
- Cardiovascular drugs and anti-hypertensive drugs (If already on those drugs)
- Physiotherapy from day one
- Speech therapy
- NG feeds if swallowing is unsatisfactory
- Occupational therapy
- Social support

The patient's blood pressure is 180 / 100 mmHg on admission. Will you treat this BP with antihypertensives?

Yes. Starting antihypertensives for strokes victims can worsen the infarct by reducing oxygen supply to viable area around the infarct (ischaemic penumbra). However, if the BP is persistently high (220 / 120 mmHg) a hypertensive should be considered. If the patient is already on antihypertensives and if the BP is stable (as in this patient), those drugs should be continued.

What are stroke mimics?

These are conditions that can closely mimic a stroke, and hence should be considered in differential diagnoses. They include;

- Seizures
- Systemic infections

- Brain tumors
- Syncope
- Trauma
- Subdural haemorrhage
- Herpes encephalitis
- Hypoglycaemia and other metabolic disorders
- Hypertensive encephalopathy
- Conversion disorders

Case20: Status epilepticus

Mr N, 23 year old patient is brought to surgical ICU with a history of multiple injuries following a road traffic accident. He was a pillion rider of a motorbike that crashed against a lamp-post. The patient was thrown about 10 meters in air and suffered multiple injuries to his limbs and chest. On admission he was unconscious and GCS was 3 / 15. There were bruising in the neck, around the eyes and behind the ear. 6 hours following admission, the patient developed a generalized tonic clonic seizure. It went on for over 15 mins before an intravenously administered anticonvulsant stopped it. Still a few minutes later, seizures recurred and were not responding any medication. After exhausting all other options, the ICU staff decided to paralyze, intubate and ventilate the patient

When would you confirm a diagnosis of status epilepticus?

Seizures lasting for more than 30 mins or recurrent attacks of seizures of similar duration without gaining full consciousness in between episodes are categorized as status epilepticus.

What could be the cause for status epilepticus in this patient?

- Trauma
- Hypoxic injury
- Subarachnoid haemorrhage
- Intracranial haemorrhage
- Toxins and withdrawal (cocaine, alcohol)

What are the other causes of status epilepticus?

- Tumours
- Infections (meningitis, encephalitis, cerebral abscess)
- Electrolyte abnormalities
- Organ failure

Can a patient who has no past history of seizures present with status epilepticus?

Yes, approximately one third of status epilepticus patients do not give a past history of seizures

How would you manage this patient?

A– Airway – keep the patient on lateral position. Do not insert airways or other material forcefully.
B - Breathing – give high flow oxygen
C – Circulation - make a quick assessment of the circulation

Most seizures would terminate spontaneously, but if not, in our setting for an adult patient, IV diazepam 5 – 10 mg is recommended (slow IV injection). If there is no response, two more doses can be given at twenty minute intervals. Due to the long half life and side effects of diazepam, it is not the drug of choice. Where available, lorazepam should be used (4mg by slow IV injection at a rate of 2mg / min). If seizures do not respond, repeat in approximately 15 minutes with the same dose and rate.

What would you do next if the patient does not respond?

Phenytoin is the second line drug for a non responding patient . It can be administered as a loading dose of 20 mg/kg at a rate not exceeding 50mg/min. If seizures recur, a dose of phenobarbitone can be tried.
The last option in event of uncontrollable seizures is to paralyze and ventilate the patient using an anesthetic agent such as thiopental or propofol. This should be done in an ICU where ventilation with close monitoring is possible.

With ICU management the seizures have been brought under control. How would you assess the patient?

Assessment depends on history, examination and investigations
History

- Details of what happened; head injury, mechanism of injury
- Eye witness account of seizure pattern

- Predisposing factors to status epilepticus
    - Past history of seizures
    - Non compliance with antiepileptic drugs
    - History of tumours, substance abuse, exposure to toxins, CNS infections
    - Drug history
    - Family history (seizure disorders)

Examination

- Direct observation of a seizure like episode is the best method to identify a true seizure
- Classic tonic clonic jerking pattern, altered and impaired level of consciousness, tongue biting, incontinence, eye rolling and frothing may indicate a true seizure.
- Even If a seizure cannot be observed directly, the tell tale signs of an event may be evident, e.g – bruising, wounds from tongue biting, incontinence, injuries incurred during seizure etc.
- The examination should also look for an aetiology for seizures
    - pattern of injury in trauma
    - evidence for narcotic use
    - focal neurological signs that may indicate a CNS infection or tumours
    - evidence for a endocrinological or a metabolic disorder

Investigations

- Serum electrolytes and random blood glucose examinations are the first line investigations in assessing seizures. The tests are simple to perform and if there is an alteration, it can be easily corrected.
- FBC to exclude infection and assess oxygen carrying capacity of blood
- Arterial blood gas assessment should be done after a prolonged seizure to exclude metabolic acidosis
- Where relevant, blood and other cultures should be done to exclude an infective process

Imaging
Non contrast CT of brain is the most available and useful investigation as it would show an intracranial haemorrhage
MRI scan may also be helpful but it is not readily available in an emergency

What is the place of EEG in status epilepticus?

An EEG is strongly considered if the patient has not recovered fully after half an hour since seizure cessation

What are the complications of status epilepticus?

- Aspiration
- Exhaustion
- Rhabdomyolysis
- Hypothermia
- Hypoxia
- Electrolyte abnormalities
- Respiratory failure

What are the principles of management of patients after the emergency is successfully handled?

- Search for an aetiology and treat accordingly
- Patient education
- Stop any substance abuse and ensure compliance with anticonvulsants

Case 21: Subarachnoid haemorrhage

Ms O, a previously healthy 35 year old female presented to a medical ward with severe headache for 2 hours. She has had headache on and off but not at regular intervals. This episode was severe than any of them. The pain was mainly occipital in location and she did not have a fever at any point. Few minutes after admission she had a blackout with a generalized tonic clonic seizure. There were no significant comorbidities in the history.
On examination, she was ill and in pain. The blood pressure was 180/ 100 with a tachycardia. Neck stiffness was apparent on CNS examination. There were retinal haemorrhages in fundi but no other focal neurological signs.

What are the possible differential diagnoses?

- Subarachnoid haemorrhage
- Meningitis
- Other non infective causes of meningeal irritation
- Migraine

What is the most likely diagnosis and why?

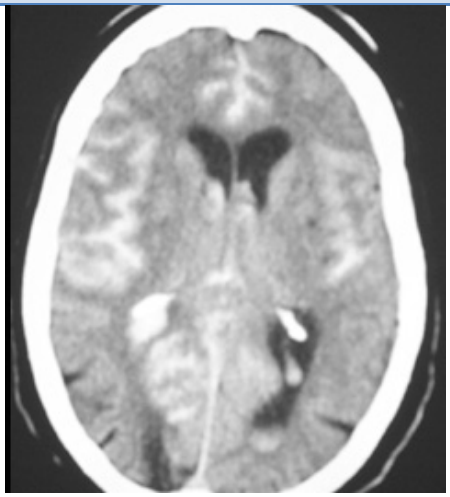
Subarachnoid haemorrhage.
Reasons:

- Sudden onset
- Previously well and afebrile (helps to exclude meningitis)
- 'Worst headache ever'
- Site of pain
- History of transient loss of consciousness with seizures
- Neck stiffness (evidence for meningeal irritation)
- Retinal haemorrhages
- Focal neurological signs are also important though not seen in this patient

What would do immediately with the differential diagnosis of subarachnoid haemorrhage in mind?

Pain relief - IM pethidine with an antiemetic
Urgent CT scan of brain

A CT scan of brain was done and it confirmed the diagnosis of a subarachnoid haemorrhage. If the CT scan was inconclusive what is your next line of investigation?



Lumbar puncture: This will show blood in subarachnoid space or if it is an old SAH there will be xanthochromia of cerebrospinal fluid.

What is the most likely cause for the SAH in this patient?

Rupture of a berry aneurysm
Bleeding from an arteriovenous malformation
Other causes for SAH include;

- Bleeding diathesis
- Primary intracranial bleed with extension into subarachnoid space
- Trauma

What is your management plan now?

Further management should be in consultation with a neurosurgical unit. The principles of management include control of blood pressure and other factors to avoid a rebleed. For this purpose, emergency neurosurgical interventions are necessary, usually within 14 days of the first episode. The prognosis of a rebleed is very poor.
The patient needs;

- Bed rest
- Nursing in a dark quiet room
- Anxiolytics such as diazepam to relieve anxiety
- Maintenance of good hydration with a fluid balance chart
- Adequate analgesia
- Nimodipine 60mg 4 hourly by mouth or via NG tube
- NG feeds if comatose
- Control of hypertension
- Stool softeners to avoid straining due to constipation

What is the rationale for using Nimodipine?

Nimodipine is a calcium channel blocker that acts against arterial vasospasms. The blood in subarachnoid space acts as an irritant causing vasospasms which might result in infarctions. Nimodipine is supposed to reduce the incidence of such infarctions.

The neurosurgical team agreed to perform surgery after an urgent digital subtraction angiogram (DSA). It showed a saccular berry aneurysm at the junction between posterior communicating artery and internal carotid artery. What are the other common sites for such aneurysms?

- Bifurcation of middle cerebral artery
- Junction between anterior cerebral artery and anterior communicating artery

What surgical options are available for this patient?

Clipping of the aneurysm with titanium clips is one option. Inserting coils to the aneurysm at time of angiography is another option.

There was a sudden deterioration of patient's condition on Day 6 after the first episode. She developed another severe headache and became drowsy. This time there was a clear left sided weakness. What is her prognosis?

Mortality can be correlated to grading of subarachnoid haemorrhage

Grade	Signs	Mortality
I	None	**0 %**
II	Neck stiffness with cranial nerve palsies	**11 %**
III	Drowsiness	**37 %**
IV	Drowsy with hemiplegia	**71 %**
V	**Prolonged coma**	**100 %**

Case 22: Acute flaccid paralysis

Mrs K, a 56 year old female was admitted with a history of sudden onset weakness of lower limbs. She was transferred from local hospital with a probable diagnosis of Guillain-Barre syndrome. The patient was well 2 weeks ago but developed a viral flu like illness which resolved in 3 – 4 days. Then within 12 hours, her legs were paralyzed. First the right leg was involved and within a few hours the left leg was also affected. On admission, she was complaining of bladder and bowel incontinence, total loss of sensation and movement of both legs. On examination, she was conscious and rational with dense paraplegia of both legs. All sensations were lost in lower limbs with a clear sensory level at T5. Reflexes of the lower limbs were absent and the plantars were equivocal. The blood pressure was 90 / 50 with a tachycardia. There was local tenderness over the thoracic spine around T3 – T4 vertebrae.

What is your view on the probable diagnosis of Guillain Barre Syndrome at local hospital?

It is quite unlikely. Though Guillain Barre Syndrome can present after an acute infection with ascending paralysis, there are many features in this history that is not compatible with Guillain Barre Syndrome. The asymmetrical involvement of limbs, presence of sensory symptoms, dense paraplegia with autonomic symptoms and the presence of a clear sensory level favours a different diagnosis

What are your concerns about this clinical picture and what makes it a medical emergency?

The suggested symptoms are all part of a compressive or non compressive lesion of the spinal cord. While some causes for such a picture are irreversible, there are many reversible causes that will allow the patient to carry on with a near normal functional ability if corrected in time.

What are the possible causes for this clinical picture?

Compressive lesions

- Extradural / intradural haematoma
- Extradural abscess
- Tuberculosis of spine
- Malignancy with primary tumour or secondaries causing compression
- Atlanto – axial subluxation
- Prolapse of a thoracic intervertebral disc (rare)
- Primary tumours of the spinal cord

Non compressive lesions

- Vasculitic infarction of cord (syphilis, polyarteritis nodosa)
- Atheromatous infarction of a segment of the cord
- Transverse myelitis
- Spinal artery thrombosis

What are the other causes of non compressive cord lesions that are less likely with this clinical picture?

- Subacute combined degeneration of the cord
- Multiple sclerosis
- Motor neuron disease (sensory symptoms are absent)
- Guillain Barre Syndrome (sensory symptoms are usually absent)
- Syringomyelia (usually asymmetrical involvement of upper limbs is seen)

How will you assess the patient?

Assess airway, breathing and circulation and do the needful

History

- Onset of symptoms, time interval, progression of symptoms
- Bladder and bowel symptoms
- Sensory loss
- Impairment of daily activities
- Difficulty in breathing

- Past history of tuberculosis, acute infections
- Past history of CVA, IHD, diabetes mellitus, hypertension, neurological disorders
- Features of a malignancy – loss of appetite, loss of weight, fractures, PV bleeding, malena
- Family history of malignancy

Examination
Is the patient in sepsis? (assess SIRS criteria)
General: emaciation, pallor (evidence of a chronic disease process) xanthelesma, xanthomata (atheromatous disease), features of a vasculitic condition
Cardiovascular: Assess haemodynamic stability (hypotension itself can cause infarctions), stigmata of infective endocarditis, murmurs
Abdomen: organomegaly, per vaginal and per rectal examination (malignant deposits)
Central nervous system:
Cranial nerves
Upper limb examination (syringomyelia)
Lower limbs: Tone, power, sensations, reflexes, plantars, gait. If there is a sensory loss, assess distribution of sensory loss (saddle back anaesthesia, sensory level etc.)
Always remember to examine the common sites of origin of bone secondaries; breast, prostate (in males), kidney, lung, and thyroid.

In this patient, there were no co-morbidities or any family history. She did not have any episodes of similar nature in the past. On examination, there was dense paraplegia involving both limbs with numbness and generalized areflexia of lower limbs. She also had bladder and bowel incontinence and there was a clear sensory level at T5 dermatome. Systemic examination did not reveal any evidence for a malignancy. However there was a significant tenderness over the spine at T4 vertebra.

How would you correlate the vertebral level with spinal segments?

Spinal segment	Corresponding vertebral segment
Upper cervical segments	**Same vertebral body**
Lower cervical segments	**One level higher**
Upper thoracic segments	**Two levels higher**
Lumbar segments	**T 10 – T 12**
Sacral segments	**T 12 – L1**
Coccygeal segments	**L1**

In this patient, the sensory level was at T5 and the corresponding vertebral level is T3. Thus the tenderness in adjacent area raises the possibility of a compressive pathology.

How would you investigate this patient?

The urgent investigation at this stage would be the imaging of spinal cord. While a CT scan will delineate the bony structures of the spinal canal, non compressive lesions and spinal cord pathologies are best seen with a MRI scan. Wherever a compressive lesion is suspected, an urgent CT and a MRI scan should be arranged. If this is impossible, at least a myelogram should be available.

In addition to imaging, ancillary testing to look for an aetiology should be requested;

- Full blood count
- Blood culture
- Ultrasound scan
- Sputum for AFB
- ESR, CRP
- Serum creatinine
- Thoracic, cervical spine and chest X rays

How would you differentiate TB of spine against malignant deposits in spine on a spinal X ray?

In malignant destruction, the vertebral body is predominantly involved. However in TB of spine, the vertebral disc margins and the disc spaces are predominantly involved.

A CT scan of spine was done and it did not show any significant lesions at the thoracic spinal levels. Therefore an urgent MRI scan was arranged.

While awaiting the MRI scan what is your mangement?

Supportive measures

- Monitoring: breath counts, bedside spirometry
- Occupational therapy
- Physiotherapy
- Good nursing care, prevention of bedsores
- Adequate nutrition
- Psychological support

Look for a cause and correct it
If there is a suspicion that the compression is due to malignancy, start IV dexamethasone 10 -100mg followed by a routine dose (4 – 10mg IV 6 hourly)
Broad spectrum antibiotics plus flucloxacillin/cloxacillin should be started if an abscess is suspected.

The MRI revealed an area of increased signal intensity in segments T3 – T6. There was a small collection of fluid anterior and posterior to the cord. The findings were compatible with a diagnosis of myelitis at T3 – T6 levels. There were no compressive lesions as suspected initially. She was managed conservatively as post infectious myelitis.

Case 23: Central nervous system infection

Mr K, a 18 year old male was transferred to a tertiary care center for further management. On admission he was drowsy with a GCS of 8 (E – 2, M – 5, V – 1). He was running a high fever for the last 3 days with chills and rigors. On the second day he had complained of neck pain and an occipital headache. He also complained of difficulty in looking at bright light. Twelve hours later the patient developed several tonic clonic seizures and was drowsy since. There was no significant past history or any travel history. On examination, the patient was found to have neck stiffness. The tone, power and the reflexes were normal in both upper and lower limbs. There were no cranial nerve palsies. Plantar reflex was up going bilaterally.

What are the possible differential diagnoses?

- Meningitis
- Encephalitis
- Meningoencephalitis
- Cerebral malaria
- Cerebral abscess
- Subarachnoid haemorrhage (rupture of a berry aneurysm)

What are the features for and against each diagnosis?

Meningitis

- History of fever and photophobia
- Rapid progression of symptomps is seen in meningococcal meningitis
- Neck pain and occipital headache can be explained by the meningeal irritation
- Neck stiffness on examination
- Drowsiness and upgoing planters are not commonly seen in isolated meningitis

Encephalitis
Drowsiness and upgoing planters point towards a cerebral involvement and hence encephalitis.
Cerebral abscess
The absence of focal neurological signs makes the diagnosis unlikely. However in a patient with fever and CNS involvement, this has to be considered.
Cerebral malaria
In cerebral malaria symptoms progress rapidly and can present with a picture similar to encephalitis

Given the constellation of symptoms of meningeal irritation and cerebral involvement, the most likely diagnosis is meningoencephalitis.

What are the likely organisms that can cause this clinical picture?

Viral: Herpes simplex and zoster, Coxasackie, mumps, measels, Japanese Encephalitis virus
Bacterial: Meningococcus, Pneumococcus, Leptospira, tuberculosis
Parasites: *Plasmodium falciparum*

What are the non infective causes you would consider in this patient?

Subarachnoid haemorrhage, leukaemia, lymphoma, carcinomatous meningitis

If you are the first attending doctor in the tertiary care center, how will you manage this patient?

Ensure the patients airway, breathing and circulation is intact
Establish IV access and take blood for investigations
A short and focused history
Examination
General: pallor, fever, icterus, lymphadenopathy, rashes
Cardiovascular: pulse, blood pressure, murmurs, peripheral stigmata of infective endocarditis

Respiratory: coexistent lower or upper respiratory tract infection (ENT infections are a common source of cerebral abscesses)
Abdomen: Hepatosplenomegaly
Central nervous system: level of consciousness, GCS, cranial nerves with examination of fundi, tone, power, reflexes of extremities, planters and clonus of lower extremities. neck stiffness, Kernig's sign

Investigations

- Full blood count (WBC /DC gives a clue on the infective organism and the platelet count is a prerequisite prior to lumbar puncture)
- Blood urea and electrolytes (if patient is in sepsis, renal impairment is a possibility)
- ECG (possibility of myocarditis)
- Chest X ray (possibility of an infective focus in lung)
- Cultures: urine, blood and CSF
- Random blood sugar to exclude hypoglycaemia
- Three thick and thin smears on subsequent days to detect the malaria parasite
- Urgent CT (to exclude a space occupying lesion before lumbar puncture, and if a contrast CT can be arranged it will show evidence for an abscess – ring enhancement or SAH)
- Urgent MRI – will be helpful in identifying encephalitis and temporal lobe involvement that will favour a diagnosis of herpes encephalitis
- EEG

An urgent CT scan was done within an hour of admission. It shows no evidence of a space occupying lesion. What will you do next?

Lumbar puncture (LP) to obtain CSF for analyses: samples can be sent for full report, Gram stain, Zeihl Neelson stain for acid fast bacilli, culture and ABST, viral studies, CSF sugar, DNA based studies (PCR).

What are the contraindications for lumbar puncture?

- Platelet count less than 80,000
- Local sepsis
- Space occupying lesion
- Cerebral oedema
- Deformities of spine
- Refusal by patient or guardian

LP was done and samples dispatched for analysis. All cultures were taken. How will you treat the patient?

While awaiting reports, broad spectrum antibiotics are started empirically. The choice of antibiotics should always be discussed with the hospital microbiologist. Later, depending on cultures and sensitivity testing, appropriate changes can be made.

A third generation cephalosporin such as cefotaxime 1g tds or ceftriaxone 1g bd has good CNS penetration. It covers most of the bacterial pathogens causing meningitis in this age group. IV acyclovir can be added if herpes encephalitis is suspected and IV quinine if malaria is a possibility (20mg/kg loading dose followed by 10mg/kg 12 hourly for 48 hours, later IV quinine can be continued or converted to oral quinine).

Supportive therapy

- NG feeds with nutritional supplements
- Physiotherapy
- Speech and language therapy
- Occupational therapy
- Prevention of bed sores
- Eye and oral care

The CSF report was available the next day;
CSF sugar – 75% of RBS value, Proteins – 0.8 g/l, RBC – not seen
Polymorphs – 2, Lymphocytes – 75, Appearance – clear
How would you interpret the findings?

Component	Normal	Pyogenic meningitis	Viral meningitis	TB meningitis	Fungal meningitis
Sugar*	Euglycemia >50%, serum hyperglycemia >30%	Less than 50% of plasma value	More than 50% of plasma value	Less than 50% of plasma value	Sometimes reduced
Proteins	15-45 mg/dl	>150 mg /dl	Mildly increased	100 – 500 mg/dl	> 1000 mg /dl with relatively less intense symptoms
Appearance	Clear	Often turbid	Clear	Turbid	Turbid
Cell counts	0-5 mono nuclear cells/mm^3	90 – 1000 polymorphs	50 – 1000 Lymphocytes	10 – 1000 Lymphocytes	100 – 1000 Lymphocytes
Pressure	5-15 cm H_2O	Increased	Normal or mildly increased	Normal or mildly increased	Normal or mildly increased
Organisms	None	In smear and culture, but absence does not exclude the diagnosis	None	Often absent in smear. (AFB detects only 40% of cases)	India ink detects 80 – 90% of cases

* Lowest CSF sugar values are seen in TB and fungal meningitis

The above picture favours a diagnosis of a viral aetiology, but a similar picture is also seen in non infective causes of meningeal irritation and in partially treated bacterial meningitis. Therefore it is wise to continue the antibiotics especially if the patient is improving clinically. Cerebral malaria cannot be excluded with this report. Quinine also should be continued if started.

The culture report is available in 4 days. It shows a growth of meningococci sensitive to ceftriaxone. The patient's clinical condition is also improving. Now what changes will you make to your regimen?

Continue ceftriaxone for 14 days
Omit acyclovir and quinine
Continue supportive therapy

Organism	**Potentially successful antibiotic combinations**
Pneumococcus	cefotaxime / ceftriaxone ± vancomycin
Meningococcus	benzylpenicillin, cefotaxime / ceftriaxone
H. Influenzae	cefotaxime / ceftriaxone
E.coli	cefotaxime / ceftriaxone
Staphylococcus aureus	flucloxacillin, vancomycin for MRSA
Mycobacterium tuberculosis	isoniazid, rifampicin, ethambutol, pyrazinamide
Fungal meningitis	amphotericin B + flucytosine

What complications might he develop?

- Prolonged convalescence
- Cranial nerve palsies
- Hydrocephalus
- Cerebral oedema
- Cerebral venous sinus thrombosis
- Deafness
- Mental subnormality

What measures would you take to prevent the spread of disease?

- Health education
- Prophylaxis:
    - Rifampicin 600mg orally 12 hourly for 2 days. (refer BNF for paediatric dosage)
    - Ciprofloxacin 500mg single dose (Adults only)

Case 24: Dengue

Mr G, a 26 year old previously healthy male who is a sanitation worker by profession was admitted with a two day history of fever. He also complained of severe myalgia, nausea and vomiting. There was no significant travel history. However, two of his family members had dengue fever during the last 3 months.

On examination, he was running a high temperature with a tachycardia (110/min). The pulse was regular with a good volume. There was no postural drop in blood pressure. No murmurs were heard on auscultation and the lungs were also clear. A tender, firm smooth surfaced liver with a regular margin was palpable 3cm below costal margin. There was no palpable splenomegaly.

What are your differential diagnoses?

- Viral flu
- Dengue fever
- Leptospirosis

What are the investigations you would request and when will you order them?

Full blood count: in dengue and other viral fevers, it will show a leucopaenia with a lymphocytosis. However a neutrophil leucocytosis may be seen early in the disease. The platelet count starts to drop in subsequent counts if it is dengue fever from third day onwards. Therefore it is better to request a full blood count on third day of fever as counts before may not reflect typical changes. Still, it is better to have a full blood count on admission to compare with later values

In Leptospirosis, there will be a clear neutrophil leucocytosis

Liver transaminases: These are elevated in dengue fever as well as leptospirosis.

Urine full report: Pus cells in urine and cellular casts are suggestive of leptospirosis

Dengue antibodies: In acute phase of illness, dengue IgM antibodies can be tested (around day 3 – 5 of fever). If IgG antibodies are checked, a rising titre should be demonstrated in two samples, one taken in acute phase and another two weeks later.

The patient was fever free on day 3 yet clinically ill. He was having a postural drop and running a tachycardia of 120/min with a low pulse volume. The respiratory rate was 24 / min. He also complained of gum bleeding while brushing his teeth in the morning. This was his full blood count; Hb: 12.7 g / dl, WBC: 3900/mm^3, N: 42%, L: 54%, PCV: 49%, Platelets: 63,000 / mm^3. What is the most likely diagnosis?

Dengue fever

How would you categorize his clinical condition with regard to the wide spectrum of manifestations of dengue infection?

People with dengue infection can be either symptomatic or asymptomatic. Of symptomatic people, it can be either simple fever which resolves quickly or classic dengue fever (without haemorrhagic manifestations or with haemorrhagic manifestations). The next stage is dengue haemorrhagic fever where the patient may or may not be in shock. If the patient goes in to shock, it is termed dengue shock syndrome. One patient can progress from one place in the spectrum to another, very quickly. The patient can be classified as having dengue fever without haemorrhagic manifestations at admission (retrospective diagnosis).
On third day, he was in dengue haemorrhagic fever without shock/impending circulatory failure (DHF grade III). The criteria for this categorization include both laboratory and clinical parameters:

- Bleeding from mucosal surfaces
- Haematemesis or melena
- Positive tourniquet test
- Petechiae, ecchymoses, or purpura

- Thrombocytopaenia (less than 100,000 / mm^3)
- A 20% rise in haematocrit compared to baseline

His condition gradually deteriorated and 48 hours later (Day 5) the house officer found him in a confused state. He was having cold clammy extremities with a rapid thready pulse. The blood pressure was unrecordable. Urine output for the last 6 hours was less than 50ml. The bystander said he was complaining of abdominal pain for the last 24 hours and had passed dark tarry coloured stools twice that day.
What is the stage of his illness now?

Dengue haemorrhagic fever with shock (dengue shock syndrome).

The following table summarizes the categorization of dengue fever and dengue haemorrhagic fever by WHO

DF / DHF	Grade	Symptoms	Laboratory findings
Dengue fever		Fever with two or more of following signs; Headache, retro-orbital pain, myalgia, arthralgia	Leucopaenia and occasional thrombocytopaenia
DHF	I	Above symptoms plus positive tourniquet test	Thrombocytopaenia <100,000 Haematocrit rise > 20%
DHF	II	Above signs plus spontaneous bleeding	Thrombocytopaenia <100,000 Haematocrit rise > 20%
DHF	III	Above signs plus impending circulatory failure	Thrombocytopaenia <100,000 Haematocrit rise > 20%
DHF	IV	Profound shock with undetectable blood pressure and pulse	Thrombocytopaenia <100,000 Haematocrit rise > 20%

If you are the admitting officer, how will you treat this patient on admission?

On admission, depending on clinical examination he has only undifferentiated fever. Blood should be sent for investigations as mentioned above. He can be managed conservatively with paracetamol for fever and should be advised to take an adequate amount of fluids orally. A fever chart should be maintained. At this stage, fever can even be managed at home. Full blood count is to be repeated in 48 hours. IV fluids are not necessary as there is no evidence of capillary leakage.

What is a postural drop and how will you measure it?

A postural drop is measured by taking patients' blood pressure while lying down and after 3 minutes of standing. A drop of systolic blood pressure by 20mmHg and diastolic pressure by 10mmHg is taken as a positive test for intravascular volume insufficiency.

According to the clinical history, by day 3 the patient is in dengue haemorrhagic fever grade II. How will you treat this patient?

This patient needs close monitoring. He should have twice daily platelet counts and haematocrit assessments. His input and output needs to be monitored and documented. Antipyretics are continued. As he has spontaneous bleeding with rising haematocrit and thrombocytopaenia, IV fluids should be started, at an initial rate of 6ml/kg/hr. All replacement IV fluids should be as normal saline or Hartmann's solution unless otherwise specified. As this is a rapid rate of infusion, his clinical condition needs to be assessed at 2 hourly intervals. If the pulse volume is good and postural drop is less, tail off the infusion to 3ml/kg/hr, continue at that rate for 6 – 12 hours and reassess the patient. If there is further improvement, discontinue IV fluids. If there is no improvement with initial infusion of 6ml/kg/hr, the rate can be increased to 10ml/kg/hr (reassess after every 2 hours). If improving, tail off the infusion gradually.

If there is no improvement despite a 10ml/kg/hr rate, recheck haematocrit.
There can be two possibilities

1. Rising haematocrit: rapid capillary loss of intravascular fluids
2. Falling haematocrit: internal bleeding

In the first instance refill the intravascular compartment with a colloid such as hetastarch at a rate of 10ml/kg/hr.
In the second instance do an urgent grouping and DT and transfuse blood at a rate of 10ml/kg/hr.
Once the patient's condition improves, start on crystalloids and tail off the infusion rate over 24 – 48 hours.

Calculation of infusion rates
There should always be stepwise increments or reductions in fluid infusions. Recommended rates are 3,6,10,20 ml/kg/hr
If this patients body weight is 50 kg;

6ml/kg/hr = 300ml / hr
3ml/kg/hr = 150ml / hr
10ml/kg/hr = 500ml / hr

If you are the attending physician 5 days after admission when the patient is in shock, how will you handle the situation?

- ABC
- Give a bolus dose of IV fluids (crystalloids) at a rate of 20ml/kg and repeat if necessary until the pulse volume picks up and blood pressure is recordable.
- Oxygen via face mask
- Exclude other causes for collapse (electrolyte imbalances, hypoglycaemia)
- Two wide bore cannulae to both arms
- Send blood for urgent grouping and DT
- If there is improvement, tail off the infusion rates to 10, 6 and 3 ml/kg/hr.
- If there is no improvement recheck haematocrit and act accordingly (colloid or blood transfusion)

His platelet count at this point is 26,000/mm3. Would you consider a platelet transfusion?

No. Platelet transfusions will be considered for this patient (with bleeding manifestations) only when his platelet count drops below 20,000/mm^3.
If there are no bleeding manifestations, there is no need to transfuse unless the platelet count falls below 10,000 / mm^3.

Fluid overload is a concern when replacing fluid in DHF. How will you assess for fluid overload?

Monitor blood pressure, pulse pressure and for the presence of a postural drop 2 hourly when the patient is on an IV infusion rate above 6ml/kg/hr. Any evidence of pulmonary oedema (bilateral basal crepitations) or an effusion is a sign of fluid overload.

Patient improved clinically in the coming days after resuscitation and aggressive fluid management at ICU. What are the indicators of improving clinical condition?

Afebrile patient with a strong pulse and good BP, without a postural drop
Good urine output
Rising platelet count (fit to be discharged when it rises above 100,000/ mm3)
Improving appetite

What are things you have to do before discharging the patient?

Notification to public health authority
Take blood for dengue IgG levels to confirm a rising titre
Health education on prevention of dengue associated mortality and morbidity

Case 25: Severe sepsis

Mrs M, a 54 year old lady presented to emergency department with drowsiness and fever. She was a diagnosed patient with diabetes (type II) for 15 years and hypertension for 5 years. She was on glibenclamide, metformin and ramipril. On examination her pulse rate was 120 / min with a good volume. BP was 70 / 40 but peripheries were warm. The respiratory rate was 24/min with right sided crepitations of lungs.
Three days following admission, her saturation dropped despite high flow oxygen. There were new bilateral pulmonary infiltrates on chest x ray. Her saturation could not be maintained without intubation and artificial ventilation.

What are the salient features regarding her Present condition?

- Ill patient
- Tachycardia
- Hypotension
- Fever
- Presence of lung signs
- Diabetes and hypertension as comorbidities

What are the possible causes for her hypotension?

- Septic shock
- Cardiogenic shock
- Anaphylaxis

What is the most likely diagnosis and how would you arrive at that conclusion?

Sepsis / Septic shock

- Warm peripheries, wide pulse pressure, a bounding pulse indicates a distributive type of shock (cf. hypovolemic shock)

- A distributive type of shock may be due to sepsis or anaphylaxis. Given her history of a concurrent lower respiratory tract infection and impaired immunity due to long standing diabetes, sepsis is more likely.
- Her JVP is not elevated. And the history is not suggestive of a recent cardiac event or pulmonary embolism, which makes cardiogenic shock an unlikely diagnosis. Other signs of cardiogenic shock and heart failure such as basal crackles (pulmonary oedema), gallop rhythm and pulses alternans are absent.

What do you mean by "shock"?

It is cellular hypoxia due to acute circulatory failure, which may be due to inadequate circulatory volume, maldistribution of flow or pump (cardiac) failure

What are the different types of shock and how would you differentiate between each?

a) Hypovolemic shock: this happens when there is acute and substantial loss of circulatory volume. (e.g – massive haemorrhage, burns)
b) Distributive shock : the circulatory volume is within normal limits for physiological functioning, but there is maldistribution of flow resulting in cellular hypoxia (e.g – aqnaphylaxis, septic shock)
c) Cardiogenic shock : pump failure resulting in acute circulatory inadequacy (e.g – valve rupture and septal rupture following myocardial infarction, massive pulmonary embolism, myocarditis, cardiac tamponade)

	Type of shock			
	Hypovolemic shock	***Distributive shock***		***Cardiogenic shock***
History	Acute blood loss, Burns, Severe diarrhoea	***Anaphylaxis*** Past history of similar episodes, exposure to allergen	***Septic shock*** Ill patient, SIRS criteria, evidence of organ hypoperfusion refractory to fluid resuscitation	Recent history of myocardial infarction Risk factors for pulmonary embolism Family history of sudden cardiac death (MI, HOCM)
Examination	Cold clammy extremities, sweating, tachycardia, narrow pulse pressure, cyanosis, delayed capillary refill time, dehydration, drowsiness, lethargy, oliguria, (clinical features depend on severity of volume loss)	Low BP, warm peripheries bronchospams erythema, urticaria angioedema, hypotension	Evidence of severe systemic or local infection (lung signs, abscess, rash), Fever, warm peripheries, widened pulse pressure, hypotension, rapid capillary refill	Elevated JVP, B/L basal crackles, new / changing murmurs, pulses alternans, gallop rhythm, signs of hypovolaemia

What are SIRS parameters?

Due to the confusion in the terminology used to define conditions related to sepsis, an international consensus has been reached in defining sepsis and related conditions.

A patient is said to have systemic inflammatory response syndrome (SIRS) if he or she fulfills 2 of the following four criteria:

a) Temperature < 36 °C or > 38 °C
b) Heart rate > 90 / min
c) Respiratory rate > 20 / min
d) WBC count < 4000/mm^3 or > 12,000/mm^3 or > 10 % immature band forms

According to the history and examination findings Mrs. M has SIRS.

Does that mean she is septic?

SIRS does not equate with sepsis. It is SIRS + evidence of infection that suggests a patient is in sepsis. In this case Mrs. M is showing features of pneumonia, so she can be categorized as having sepsis. Evidence for infection does not mean evidence of bacteraemia. In fact, only 50 % of septic patients have positive cultures.

What is severe sepsis and septic shock; are they same or different?

They are two different things. Severe sepsis is sepsis with evidence of organ dysfunction, hypoperfusion and hypotension. Perfusion abnormalities can be gauged by oliguria, lactic acidosis or acute alteration of mental state (plus any other feature clinicians elicit).

Septic shock is said to be present when a patient is in severe sepsis not responsive to adequate fluid resuscitation. Mrs. M can be categorized as having severe sepsis due to her hypotension. If she does not respond to adequate fluid resuscitation, she is in septic shock.

How will you manage this patient?

The following investigations should be performed:

Haematological

- Full blood count: Hb and haematocrit to assess oxygen carrying capacity of blood, WBC / DC to establish likelihood of infection and SIRS criteria, platelet count to detect early clotting abnormalities. It may be high during the initial acute phase response but might drop drastically with complications such as DIC
- Clotting profile: to detect early abnormalities in clotting cascade

Biochemical

- Blood urea, serum creatinine: to detect acute renal failure
- Liver profile: if hepatorenal failure is suspected
- RBS / FBS: as glycaemic control is critical for a good outcome

Microbiological

- Blood, sputum cultures with ABST: to detect causative organisms. Though not indicated in this patient, any evidence of infection in a particular system needs sampling of body fluids of that system to detect causative microbes. (e.g – lumbar puncture in a septic patient with meningism, bile for culture in a post operative septic patient with a T tube)

Others

- ECG
- Chest X ray; changes may indicate a focus of infection (pneumonia) or a complication of sepsis (ARDS)

Treatment of the patient includes

a) Resuscitation
b) Treating acute organ dysfunction
c) Eliminating source of infection

Resuscitation

Assess airway, breathing and circulation. Since Mrs. M is conscious and rational it is likely that there is no severe hypoxia. Still she can rapidly deteriorate to a state which needs urgent ventilation. So monitoring saturation and giving supplementary

oxygen is a must. The need for ICU admission and possibility of ventilation should be assessed.

Her blood pressure has to be normalized. The mean arterial pressure should be above 65 mmHg. Crystalloids should be infused until the BP picks up. It is not unusual to require around 4 – 6 L of fluid in initial resuscitation phase. At this stage, colloids show no benefit over crystalloids. If the patient is nonresponsive to initial fluid challenge, further infusions are better guided by CVP measurements.

Treating acute organ dysfunction
Rather than treating, multi organ failure should be prevented. By keeping a close tab on renal and liver functions, early deterioration can be detected. Monitoring input and output is a must. Maintaining an adequate urine output is necessary to prevent acute renal failure and hepatorenal failure. Gastrointestinal failure can be prevented by enteral feeding. Any organ dysfunction should be managed on particular guidelines and treatment protocols

Treating the infection
Broad spectrum antibiotics should be started empirically after taking cultures. Later, depending on ABST, the choice can be narrowed.

In Mrs. M, community acquired pneumonia was the most likely primary diagnosis. A broad spectrum antibiotic with good gram positive cover such as coamoxyclav can be started. If atypical pneumonia is a possibility erythromycin / clarythromycin can be added. An alterantive would be cefuroxime (gram positive and negative cover) with a macrolide. All antibiotics are started with intravenous dosing.

In other patients, the clinical situation may guide empirical antibiotic treatment

- Indwelling IV lines, CVP lines, catheters, IV drug abuse – add cloxacillin for Staphylococcus cover
- Patients with burns or neutropaenia – ceftazidime, ticarcillin – tazobactum for pseudomonas cover
- Suspected abscess, intra- abdominal or gynaecological sepsis – Second or third generation cephalosporins + metronidazole for anaerobic cover
- Severely ill patient, biliary sepsis – imipenem, meropenem

Antibiotic choice may be limited by patient related factors such as comorbidities, allergies, age and organ dysfunction

What is the role of IV steroids in sepsis?

Recent trials have shown that in a selected group of patients with adrenal insufficiency and sepsis, IV steroids reduce mortality. ACTH stimulation tests have indicated that almost 75 % of patients are in fact having some evidence of adrenal insufficiency. Therefore in a setting where routine ACTH stimulation testing cannot be carried out, universal administration of IV hydrocortisone should be considered.

What are the organ dysfunctions that can occur in septic shock?

Acute renal failure

a) Disseminated intravascular coagulation
b) Acute respiratory distress syndrome (ARDS)

What is the likely complication this patient has developed?

ARDS / acute lung injury

How would you define ARDS / Acute lung injury?

Acute lung injury is said to be present if there is

a) Respiratory distress
b) Bilateral new, homogenous or patchy pulmonary infiltrates
c) No apparent cardiac cause for pulmonary oedema

d) Arterial oxygen tension / fraction of inspired Oxygen ratio < 300

Acute respiratory distress syndrome is present if criteria a, b and c are fulfilled with an arterial oxygen tension/fraction of inspired oxygen ratio < 200.

Briefly describe the pathophysiology of ARDS

a) Inflammatory mediators (bacterial endotoxins, IL – 6, Il – 1, TNF – α, arachidonic acid derivatives) will damage the lung capillary endothelium resulting in exudation of protein rich fluid. This is called the exudative phase
b) Influx of neutrophils and later macrophages and lymphocytes, will release cytokines to start organization and repair. This is the second phase with collagen deposition and proliferation of type 2 pneumocytes.
c) The repair will eventually result in fibrosis which is the third phase. If the injury is extensive, gas transfer is severely restricted. The progression from stage one to three may take weeks or can happen over a few days.

How will you treat Mrs. M if she has ARDS?

a) The basis of treatment is to eradicate the infection that is the source of injury
b) Supportive treatment may include ventilation (to reduce work of breathing). Ventilation may be pressure limited to reduce barotrauma.
c) Careful monitoring of intravascular volume with CVP/intra arterial monitoring and limiting fluid infusion to reduce pulmonary oedema
d) Prone position, aerosolized prostacyclins and surfactant, inhaled nitric oxide have all been tried at experimental level.
e) Management of ARDS must be done at an ICU setting

Case 26: Deep vein thrombosis

A 43 year old female patient, Mrs. X was diagnosed to have uterine fibroids for which she underwent total abdominal hysterectomy. After 5 days of hospital stay she was discharged without any post operative complications. However, she had stayed in bed for most of the time following discharge to avoid 'tearing' of her suture site. On tenth day after surgery, she developed severe pain in left leg with fever. Within hours the leg swelled to twice its normal size from thigh downwards with pitting oedema. She was brought to hospital immediately. She was not on any drugs prior to surgery except the oral contraceptives.

What is the post surgical complication she has developed?

Deep vein thrombosis (DVT)

What are the risk factors for this lady to develop DVT?

- Pelvic surgery
- Prolonged period of immobility following surgery
- Not being on DVT prophylaxis after surgery
- Use of oral contraceptive pills

What are the other risk factors for DVT that are not present in this patient?

- Pelvic malignancy
- Pregnancy / puerperium
- Local trauma and leg fractures
- Hematological conditions with a predisposition for coagulation (Polycythaemia, thrombocythaemia, factor V laden deficiency, hyperhomocystinaemia)
- Nephrotic syndrome

Soon after admission to hospital, she was assessed by doctors and rushed for a duplex scan of the venous system of lower

limbs. The doctor's assessment sheet mentioned of a Well's score of 5.

What is Well's score and how will it help to diagnose DVT?

Well's score is a clinical scoring system that predicts the likelihood of DVT (pretest probability). It was developed by P.S Wells.

Clinical feature	**Score**
History	
Active cancer	1
Paralysis, paresis or plaster immobilization of leg	1
Bedridden for more than 3 days or major surgery within 4 weeks	1
Examination	
Localized tenderness along the deep venous system	1
Entire leg swollen	1
Calf swelling more than 3cm when compared with the other leg	1
Pitting oedema (greater in symptomatic leg)	1
Collateral superficial venous dilation	1
Alternative diagnosis for limb swelling such as cellulitis	-2

Interpretation of Well's score

- Score greater than 3 – High probability of DVT
- Score between 1 and 2 – Moderate probability of DVT
- Score 0 or less – low probability of DVT

The duplex scan showed a filling defect in the femoral vein and popliteal vein. A probable diagnosis of DVT was made on duplex findings and clinical picture. How would you proceed from here onwards?

The ideal test to diagnose deep vein thrombosis is a venogram. In this situation a venogram is an invasive and a hazardous test. Since the clinical evidence strongly points towards a diagnosis of DVT, it is fair to start treatment without absolute confirmation.

Other tests to request at this stage include chest X ray, full blood count, baseline clotting profile (anticoagulation will be necessary), arterial blood gas and serum electrolytes to assess the metabolic status.
The aims of treatment include relieving symptoms, achieving venous patency, preventing further episodes of thrombosis and pulmonary embolism. The patient should rest with the foot end of bed raised. Graduated compression stockings should be applied to both legs to prevent further events. The process of clot formation starts at the time of surgery and not after 5 – 10 days. Ideally she should have had this simple method of prophylaxis during perioperative period. Anticoagulation should start immediately with heparin. Either low molecular weight or unfractionated heparin can be used. Warfarin is not used in acute stage as it takes time for action. Unfractionated heparin can be given as a loading dose of 100U/kg and then as an infusion at rate of 12,000 units at rate of 1000U / hour twice daily. The heparin dose has to be adjusted to maintain a 1.5 – 2.5 times the control time of activated partial thromboplastin time (APTT). Baseline APTT should be done before starting heparin and rechecked 6 hourly until control is achieved. If low molecular weight heparin is used there is no need to monitor with APTT. The therapeutic dose is 175U/kg once daily of tinzaparin, 200U/kg once daily of dalteparin or 1.5 mg/kg once daily of enoxaparin. Low molecular weight heparin is quicker and more efficient in gaining venous patency and reducing post thrombotic complications.

What are the absolute contraindications for heparin?

- Active bleeding
- Sensitivity to heparin

Patients with active bleeding, recent upper GI or neurological haemorrhage, renal insufficiency and thrombocytopaenia are considered at increased risk when starting subcutaneous heparin. They have to be monitored closely with dose reductions as necessary.

What is the long term follow up plan for this patient?

This patient needs lifelong anticoagulation and heparin is quite unsuitable as a long term option due to side effects such as osteoporosis and thrombocytopaenia. Besides, heparin being a protein is unsuitable for oral ingestion. Therefore the patient needs be converted to warfarin. Warfarin is started concomitantly with heparin and its activity can be monitored with PT/INR. Once the INR (international normalized ratio) is stabilized between 2 – 3, heparin can be stopped and warfarin continued with monthly monitoring of INR.

What are the complications this patient can develop because of DVT?

- Blister formation and ulceration
- Venous gangrene
- Pulmonary embolism
- Paradoxical embolism with strokes

Provided her INR is in appropriate range, and she is on warfarin 5mg daily, how would you advice her on discharge?

She should be advised to take warfarin on an empty stomach and avoid food 2 hours after ingestion as it might interfere with warfarin absorption. She should mention that she is on warfarin whenever she consults a doctor as other medication can interfere with the action of warfarin. If there are any manifestations of bleeding such as gum bleeding, petechaie, or pupura, she should stop warfarin immediately and see a doctor.

Case 27: Pulmonary embolism

Further to the case scenario 26; Mrs. X was started on anticoagulants and was responding well with reduced leg swelling and pain. However, three days later she complained of sudden onset right sided chest pain and severe shortness of breath. On examination she was cyanosed and gasping. The peripheries were cold and the radial pulse was impalpable. BP measured with a mechanical cuff read a value of 67/43 mmHg. The physician in attendance suspected a 'massive' pulmonary embolus.

What do you understand by the phrase 'massive' pulmonary embolus?

This refers to a large embolus from distal thrombus, lodging in and blocking a main pulmonary artery. The lesser vascular obstructions with medium sized and small sized emboli are mainly differentiated on clinical picture. In case of a massive pulmonary embolus, the patient collapses and becomes haemodynamically unstable with low or unrecordable BP as the entire circulation is compromised. The signs include gallop rhythm, tachycardia and a right ventricular heave. The outcome of this picture is poor.

A medium sized embolus will result in infarction of a smaller area of the lung. Nevertheless symptoms may still arise due to inflammatory response. It includes cough, dyspnoea, pleuritic chest pain and haemoptysis. Fever may occur due to inflammation and it may be difficult to differentiate from a pneumonia especially in a young individual. The signs include pleural effusion (unilateral) and pleural rub (most often these signs are absent).

Smaller emboli are largely asymptomatic or may present with chest pain, fever and unilateral pleural effusions. If episodes are recurrent, pulmonary hypertension is a possibility.

How will you manage this situation?

First stabilize the patient;
Assess airway – suck out secretions, position the air way and if necessary insert an oral airway
Assess breathing - give high flow oxygen via face mask. Connect to saturation monitor and assess the adequacy of peripheral saturation which is an indirect indicator of perfusion of vital organs. However, due to shock and peripheral vasoconstriction, the value in saturation monitor may be less than the actual value. It is important to assess the need for ventilation, book an ICU bed and call an anesthetist.
Assess circulation – this picture is equivalent to cardiogenic shock and pump failure. There is an inadequate cardiac output and pooling of blood on the systemic veins. Therefore infusing further fluids in to the veins will not make the pressure pick up. If giving fluids to maintain blood pressure, it should be a colloid such as hetastarch 500ml in rapid infusion. In most occasions inotropic support is necessary to maintain blood pressure. It is important to get IV access before the situation deteriorates further and at the same time take blood for essential investigations:

- Full blood count; to assess oxygen carrying capacity of blood (Hb level), platelet count is necessary before starting anticoagulation (unless it is an emergency)
- Blood urea, serum creatinine: To assess any renal impairment due to hypoperfusion
- Random blood sugar, serum electrolytes: To detect and correct any metabolic abnormality that might further complicate this situation
- Baseline clotting profile with APTT and PT/INR: before starting anticoagulants
- Arterial blood gas: vital investigation at this point to detect oxygen saturation of arterial circulation and acidosis.
- Chest X ray and ECG: might show some changes in acute phase (see below).

The aims in treatment include stabilizing her haemodynamically, restoring the patency of pulmonary circulation and preventing further emboli.

Given her current blood pressure, she should be started on a noradrenaline infusion (refer tables for infusion rates, 0.05 – 5 µg / kg / min). If the blood pressure was between 80 – 90 dopamine can be used (5 – 20 ug / kg / min) and If it is marginally low and above 90mmHg, dobutamine is the drug of choice (5 – 40 ug / kg / min)

As the pressure picks up she should be started on anticoagulants. See previous section on starting and maintaining anticoagulation. The key issue is that all of this should be done on clinical diagnosis alone without wasting time for investigations to confirm the clinical suspicion. Chest X rays and diagnostic investigations such as V/Q scanning are of academic interest only in such acute situations.

What are the tests that will be of diagnostic value regarding pulmonary embolism?

Pulmonary angiogram is an invasive test and not recommended in clinically unstable patients. Still in some settings it is done to assess the degree of severity and anatomy of the obstruction.

A ventilation perfusion scan is the commonly used method of imaging in many centers. Small radionuclide tagged molecules are injected to veins and the pulmonary circulation is assessed with a gamma camera. The sensitivity can be increased by adding the ventilation component to the scan by getting the patient to inhale air with radioactive Xenon gas. Any area in lung that is ventilated but not perfused (in acute stage) is suspected to have a pulmonary embolus. Plasma D dimer levels have a negative predictive value (if it is not elevated, pulmonary embolus is unlikely).

Results of her the investigations are as follows;

- Arterial blood gas; severe hypoxaemia with pO_2 60mmHg (while on high flow oxygen)
- ECG; right axis deviation
- Plasma D dimer level: > 0.2 ng/ml
- Chest radiograph: right side hemidiaphragmatic elevation, small effusion on right side
- V/Q scan: could not be done as the patient was unstable

What is the place for thrombolysis in this patient?

Streptokinase will establish vascular patency by lysing the embolus. Surgical embolectomy is not a practical option in this situation. Chemical embolectomy is preferred when there is a massive pulmonary embolus and the patient is in shock (as is the case with this patient).
IV streptokinase can be given as 250,000 units intravenously over 30 minutes and 100,000 units/hour for 24 to 72 hours

With thrombolysis, she improved clinically. Her relations inquired about the possibility of inserting an IVC filter to prevent further clots from getting entrapped in the pulmonary circulation. What is your opinion on such an intervention?

IVC plication and insertion of filters is an accepted practice. However it is only for patients with recurrent emboli or for those with bleeding disorders which prevent the use of anticoagulants. Such a measure is not indicated in this patient.

Case 28: Poisoning

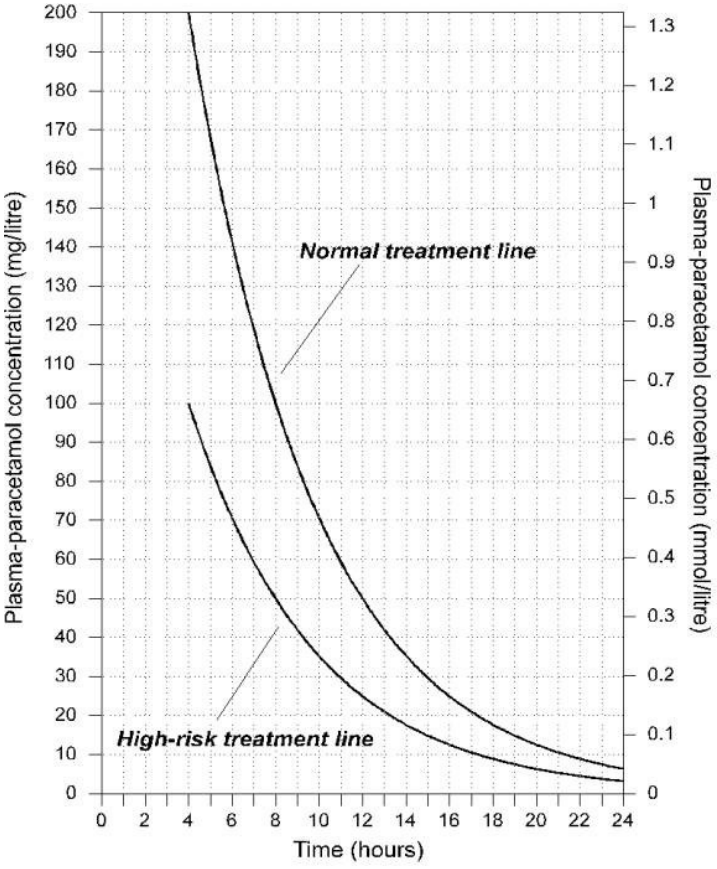
Miss R, A 26 year old, previously healthy girl was admitted to the emergency treatment unit. She had ingested 20 tablets of paracetamol 3 hours ago (tablet strength 500 mg). On admission she was stable, afebrile and anicteric. The pulse rate was 92 / min, respiratory rate was 18 / min and the BP was 120 / 70 mmHg. There were no lung signs or organomegaly. Her body weight was 40 kg.

Are you worried about the amount of paracetamol ingested? If so why?

Yes, the toxic dose of paracetamol is > 150 mg / kg. A dose above 200 mg / kg is considered fatal. In this patient the ingested dose is 250 mg / kg.

What is a Ramack – Matthews nomogram ?

It is a graph where the plasma paracetamol concentration is plotted against the time elapsed since ingestion (see picture). There are two lines, the normal treatment line and the high risk treatment line. High risk group involves people taking enzyme inducing drugs such as phenytoin, carbamazepine, rifampicn and alcohol as well as those with chronic liver disease. They need initiation of treatment with the antitode at a lower threshold of plasma paracetamol. Any plasma concentration that falls to the right of the curve should be treated with the antidote.



Why is paracetamol toxic in overdose?

The toxicity is related to its metabolism. Paracetamol is metabolized by glucoronization and sulphonization in the liver. When the ingested dose saturates this pathway of metabolism, an intermediary metabolite, N – acetyl p – benzoquinonimine is produced via the P450 enzymes. This toxic substance needs to be reduced by glutathione which can get rapidly depleted. If they are depleted, the reduction is done via the sulphydryl groups of plasma membrane proteins which cause disruption of the cell and necrosis.

What are the organs mostly effected by paracetamol poisoning?

- Liver
- Kidney
- Pancreas

What are the antidotes for paracetamol poisoning?

- N acetyl cysteine (NAC)
- Methionine

How will you treat this patient?

Step 1: confirm whether she has actually ingested the said number of tablets. NAC is an expensive drug.
Step 2: take blood for serum paracetamol levels, PT / INR, liver function tests, full blood count, random blood sugar and electrolytes. This will serve as a baseline to assess improvement or deterioration. The tests have to be repeated daily.
Step 3: transfer the patient immediately to a facility where NAC is available.
Step 4: start an infusion of NAC 150 mg / kg in 200ml of 5 % dextrose over 15 mins, 50 mg / kg NAC in 500 ml of 5% dextrose over 1 hour,100 mg / kg NAC in 1000 ml of 5% dextrose over 16 hours.
Step 5: monitor the response with serial serum investigations

Would you give activated charcoal to this patient?

No, it is ineffective after 2 h of ingestion. If the patient presents within 2 hours, 50g of charcoal can be given in 200ml of water

Can you give methionine to this patient?

Methionine is cheaper than NAC and in an asymptomatic patient it is as effective as NAC. Therefore if the patient presents within 8 hours of ingestion and if the tranasaminases are normal, methionine can be prescribed as 2.5 g at 4 hourly intervals (maximum dose of 10g in 24 hours).

The patient complains of a rash and itchiness while on NAC. What would you do?

About 15 % of patients get a hypersensitivity reaction to NAC. The infusion can be temporarily stopped or slowed, but it must be recommenced.

24 hours later, the patient complains of right hypochondrial pain. The liver function tests at this time show elevated transaminases. What would you do?

This may be a sign of impending hepatocellular failure. Patient needs to be monitored closely with input and output charted. Hypogycaemia should be corrected with 50 % dextrose intravenously. NAC should be continued at a dose of 100mg / kg until the INR falls below 2.

What are the clinical features of paracetamol poisoning?

The effects of poisoning can be divided in to 4 stages

Stage I: (first 24 hours)

- Asymptomatic
- Nausea, vomiting
- Rarely metabolic acidosis

Stage II: (24 – 72 hours)

- May have right hypochondrial pain
- Altered investigation results
- Asymptomatic patients on most occasions

Stage III: (72 – 96 hours, high risk period)

- Hepatic encephalopathy
- Disseminated intravascular coagulation
- Hypoglycemia
- Pancreatitis
- Myocarditis

Stage IV: (96 – 2 weeks)

Hepatic failure and death
Complete recovery

Within 3 days from ingestion the patient develops icterus, confusion and alteration of consciousness. She has flapping tremors. What is the diagnosis?

Hepatic encephalopathy

How would you manage her now?

- Continue NAC
- Avoid sedation and diuretics
- Lactulose 90 to 150 ml in three divided doses
- Correct hypoglycemia with 10 % dextrose
- Correct clotting abnormalities with IV Vitamin K
- If there is raised intracranial pressure, treat with mannitol

When will you stop NAC?

If the liver function tests are normal and if the INR is under 2 with a clinically improving patient, NAC can be stopped.

Case 29: Snake bite

Mr J, a 25 year old male was brought to the medical ward at 5.00p.m after being bitten by an unknown snake. After searching the vicinity, the villagers had found a snake in a nearby bush. They killed it and brought it for the physician's inspection. The doctor correctly identified the snake as a Russell's viper. On examination the patient was anxious and sweating. The bite site was swollen but without blistering. There was no evidence of spontaneous bleeding. Pulse rate was 96/min and BP was 130/70 mmHg.

Are you going to give antivenom to this patient?

No. At the moment he does not show any evidence of envenoming. Finding a Russell's viper in the vicinity does not mean it is the biting snake.

What is your management at this point?

Reassure the patient; not all snakes are venomous and even if the snake is venomous it may not have injected sufficient venom. Even if a lethal dose is injected, there is antivenom to counter the effects

- Wash the area with soap and water
- Avoid mobilizing the patient
- Keep the foot elevated
- Avoid tourniquet
- Adequate analgesia (paracetamol)
- Tetanus toxoid
- Antibiotics are not routinely used
- Maintain an input output chart
- Monitor the vital signs regularly
- Take blood for baseline investigations: FBC, blood urea and serum creatinine, clotting profile, twenty minute whole blood clotting test (20WBCT)

Twenty minutes later, the patient complaints of severe abdominal pain. Ptosis becomes apparent on the left eye. Patient complains of double vision on looking to one side. The 20WBCT test is positive (blood has not clotted at 20 minutes). There is also a marked swelling at the bite site.
Is there an indication for antivenom now?

Yes. The patient is showing two independent indications for antivenom, neurotoxicity and a positive 20WBCT. Both are indicators of systemic envenoming.

What else should you consider before starting antivenom?

The most important thing is whether the antivenom is useful against the biting snake. The Indian Haffkine polyspecific antivenom is effective against cobra, Russell's viper, Indian krait and saw scale viper. It is NOT effective and may even be harmful in hump nosed viper, green pit viper and Ceylon krait bites.

How would you use the data available, to make an educated guess about the biting snake?

Epidemiological factors:
Geographical location: Krait bites and Russell's viper bites are common in dry zone whereas the hump nosed viper bites are common in wet zone. Cobra bites may occur anywhere in the island but are commoner in the dry zone. Saw scale viper bites are very rare. (Even in dry semi arid areas where these snakes are more likely to be found)
Time of bite: Bites by common kraits occur almost exclusively at night time. Other snakes show less diurnal activity.
Place of bite: Usually snakebites are limited to the tips of extremities. One exception is the krait bites where the snake strikes on any part of the body as the victims mostly get bitten during sleep.

Clinical features:

Snake	Neuro-toxicity	Coagul-opathy	Local effects	Nephro-toxicity	Myotoxicity
Cobra	+	-	++	-	**-**
Russell's viper	+	++	+	-	**-**
Hump nosed viper	-	+	++	++	**-**
Saw scale viper	-	++	-	-	**-**
Kraits	++	-	-	-	**-**
Sea snakes	**-**	**-**	**-**	**-**	**++**

Evidence for neurotoxicity makes cobra, krait and Russell's viper, the likely snakes. Onset of coagulopathy points towards the vipers. Kraits have minimal local effects.

How will you give antivenom to this patient?

The antivenom currently available in Sri Lanka is the Haffkine polyspecific antivenom which needs to be administered in its full dose (10 vials per person).

Each vial has to be dissolved in 10ml of distilled water and the total would make a volume of 100ml. A further 200ml of normal saline is added to the diluted antivenom and run slowly in to the patient intravenously. Though it is recommended to complete the infusion within one hour, in many occasions it is impossible to do so due to the reactions.

Within 10 minutes of starting the infusion, the patient gets an urticarial rash and complains of breathlessness. What would you do?

First stop infusion and assess the patient. If there is a compromised airway and anaphylactic shock, act accordingly. If not, give Hydrocortisone 200mg IV stat and promethazine 25 mg IM stat. Observe for a while and restart the infusion slowly. If still having reactions, temporarily stop the infusion for a few hours. It is important to monitor the vital signs while the infusion is continuing.

The snake that was brought is a juvenile one. Will you reduce the dose of antivenom?

No. Despite their age, snakes can inject the same amount of venom. There is no paediatric dose for antivenom. The adult dose should be given to children as well.

Antivenom infusion is over. What would you do next?

- Observe for clinical improvement
- Look for objective evidence; repeat 20WBCT. If blood does not clot, repeat the dose of antivenom. Otherwise close observation would be enough.

12 hours after the first antivenom infusion (20WBCT has clotted), ptosis still persists. Will you repeat another round of antivenom?

No. Ptosis will take time to settle and it is unrelated to the level of free venom in blood. Usually in cobra and krait bites (where neurotoxicity is well manifested) only one round of antivenom is indicated even if residual paralysis persists.

After 3 days of hospital stay the biochemical parameters are normal and the patient is clinically well. The wound at bite site has healed. How will you advice the patient on discharge?

Avoid dwellings that are likely to harbour snakes (decaying logs, thick undergrowth).
Keep the house and neighborhood clean and free of rats and other small animals
Avoid walking in areas with undergrowth at night. If you do, carry a torch and tread heavily
Always cover your lower extremities; do not walk barefoot
Avoid sleeping on floor
In case of a snakebite:

- Don't panic
- Wash the bite site with soap and water
- Immobilize the limb
- Keep ice packs and take paracetamol as analgesia
- Avoid alcohol and aspirin
- Take the patient to nearest hospital and if possible, take the snake as well
- Do not cut or chew at the bite site (common practice with traditional healers). It can damage vital structures and can introduce infection

Case 30: Hypovolaemic shock

Mr F, a 34 year old man was admitted to surgical casualty with severe epigastric pain. He has had several episodes of haematemesis since childhood. He was running a fever with purpura of skin and gum bleeding. On examination, he was very pale (Hb-5.1g/dl). He was later admitted to MICU with a provisional diagnosis of dengue. However, as the clinical features were not compatible, an urgent CT scan of abdomen was done. It showed a massive haemangioma involving both lobes of the liver. While awaiting surgery he developed another bout of severe abdominal pain. This time he was confused, drowsy with a pulse rate of 124/min. The peripheries were cold and clammy. Pulse volume was very low. Despite resuscitation with fluids, blood and inotropes, his urine output was persistently low. His BP was hovering around 80/50mmHg until it finally crashed. The patient died within 4 hours.

What could have been the cause of death?

Massive bleeding from the haemangioma resulting in hypovolaemic shock.

What is hypovolaemic shock?

It is the organ dysfunction due to hypoperfusion resulting from the rapid loss of intravascular fluid volume

How would you explain his clinical picture?

His clinical picture is partly due to the effects of haemangioma and partly due to the complications of hypovolaemic shock. The loss of platelets within the haemangioma will explain the clotting defects giving rise to purpuric patches and gum bleeding. Small amounts of bleeding and distension of the liver capsule would have caused epigastric pain but the later presentation is entirely due to a massive haemorrhage resulting in shock.

The body has many compensatory mechanisms against shock. Slight bleeds may be covered without any overt manifestations.

- With blood loss heart rate rises to maintain an adequate cardiac output.
- Later there will be peripheral vasoconstriction to maintain the systemic blood pressure. Vital organs such as the heart, brain and kidneys are perfused at the expense of cutaneous and splanchnic circulation
- The low volume state is sensed by the volume receptors (pulmonary, atrial and venous stretch receptors) and by the pressure receptors (aortic and carotid baroreceptors) which mediate a rise in sympathetic tone and a drop in basal vagal tone.
- The over activation of sympathetic system in hypovolaemia (partly triggered by emotional stimuli acting on the hypothalamus) releases renin from juxtaglomerular apparatus in kidney. The activation of renin – angiotensin – aldosterone axis results in solute and water retention partly compensating for the loss of fluids. The sympathetic tone has a direct vasoconstrictor effect and the potent vasoconstrictor angiotensin II adds to the effect by constricting the vessels to maintain blood pressure
- The loss of volume, sympathetic overdrive and osmoreceptors stimulate the release of antidiuretic hormone (ADH). The rise in ADH will enhance water absorption from collecting ducts and distal tubules. All these mechanisms will result in a reduced urine output

If you are the attending house officer, how will you assess the degree of fluid / blood loss?

Class	Definition (% blood loss)	Pulse	RR	Pulse pressure	Level of conscious-ness	UOP
I	< 15 %	No change	No change	No change	No change	No change
II	15- 30 %	> 100	> 20	drops	Anxiety	< 30 ml / h
III	30-40 %	> 120	>30	Further drop	Confusion and agitation	< 20 ml / h
IV	> 40 %	Marked tachy-cardia	Rapid or depressed respiration	Unrecord able diastolic pressure	Comatose patient	Reduced or no UOP

Class IV haemorrhage is immediately life threatening
Depending on his clinical features, he would have been at class III haemorrhage when the house officer first attended to him

If you are the house officer how would you attempt resuscitation on this patient?

A – Ensure that airway is clear and free of secretions. If patient is unconscious, oral, nasal or oropharyngeal airways can be inserted
B – Ensure that the patient gets 100 % oxygen (unless he is having chronic obstructive airway disease). A venturi mask will enable to deliver a desired percentage of oxygen. If unconscious or in a state of impending cardiac arrest, intubation and ambu ventilaton should be carried out
C – Circulation
The goals of resuscitation are to

- compensate for the ongoing bleeding
- prevent further bleeds

Compensating for blood loss
Insert two wide bore cannulae, take blood for FBC, BU/SE, PT /INR, GP / DT and immediately start infusing crystalloids. The foot end of the bed should be raised and parameters such as BP, pulse rate and respiratory rate are continuously assessed. After 2L of crystalloids, if the BP is still low, 1L of colloids (hetastarch, dextran) can be given. The best colloid is blood. In acute emergencies non cross matched group specific blood can be transfused.

Preventing further bleeds
This includes a definitive treatment measure (in this case tying the hepatic artery in surgery).

What are the goals in resuscitation?

The resuscitation in any form of shock is goal directed.
The goals in a situation of hypovolaemic shock are,

-Hb > 8 g / dl
-Haematocrit > 28 %
-SpO2 > 95%
-Urine output > 30 ml / h
-CVP value > 8 – 10 cm water

What are the steps in subsequent management?

History

- Causative event
- Previous episodes
- Evidence for a clotting defect
- Cardiovascular fitness prior to episode
- Specific symptoms related to the underlying condition (GI bleeds in oesophageal varices, malaena in gastric ulcers, and severe backache in aortic aneurysms)

Examination: Assess the degree of shock and classify according to the table given above (in patients with hypovolaemic shock of unknown aetiology, always consider bleeding from chest, thigh, and abdomen).

Investigations

- FBC – to assess Hb level to estimate oxygen carrying capacity of blood, platelet count may indicate a coagulopathy and the white cell count is useful to assess ongoing infection
- BU/SE – to detect renal impairment, dehydration and electrolyte imbalances
- Blood for grouping and DT
- PT / INR / APTT – to assess clotting abnormalities
- *Pregnancy testing is a must for females*

Imaging studies

Imaging studies such as plain radiography (CXR erect) to detect gas under the diaphragm, U/S scan abdomen to detect pregnancy related bleeding or damage to internal organs should only be undertaken once the patient is adequately resuscitated and stable.

What do you know about resuscitation with colloids and crystalloids, which is better? What does the evidence show?

The argument for using colloids is based on the hypothesis that less colloid is needed to maintain the intravascular volume. Also, increased oncotic pressure with colloids makes pulmonary oedema less likely. However the evidence does not show any survival benefit in patients resuscitated with colloids over those resuscitated with crystalloids.