Dr Rob CM Stephens
Consultant in Anaesthesia
Honorary Senior Lecturer UCL
Google ‘UCL stephens’
• Video
Anaesthesia & Perioperative Medicine

by Rob Stephens

Year 4 MBBS @ UCL

Mean arterial pressure = CO x SVR

come to theatre with us to be part of the team
see & change physiology in action
got to do practical things

practice real airway skills
have great tutorials with enthusiasts
learn with happy doctors who love their job

know about risk: oxygen and drugs
learn how to relieve pain
learn about fluids & resuscitation

brought to you by:

UCL Anaesthesia
UCLH
Whittington
RFH
Rob CM Stephens
Basil Almajdi
Jeremy Prout

Search online for 'ucl anaesthesia students'

www.ucl.ac.uk/anaesthesia/StudentsandTrainees/students
Introduction

What’s this lecture?

• How basic science underpins Medicine!
• Show relevance!
• Introduce some clinical concepts..
• Walk you through a patient’s journey
Contents

Our patient, man or woman, from anywhere

Home symptoms
See GP
Tests at the GP’s
Sees Doctors at hospital
Needs surgery
Has surgery
....with complications
Goes home... at last!
We’re going to cover

• Anatomy
• Cancer
• Chest X Ray
• Electrocardiographs ECG
• Blood
• Anaemia
• Ethics – consent and confidentiality
• And more!!
Our patient
Pictures
At Home

78 years old

Several chronic medical conditions..

Starts to feel discomfort “in the front of my belly” ..

6 weeks go by.....
“in the front of my belly”
List the organs that might be involved...
Abdomen and Pelvis

- GI tract - stomach, small bowl, large bowl (Gastrointestinal)
- Spleen
- Liver, Gall bladder, Biliary tree (Hepato-Pancreato-Biliary ‘HPB’)
- Pancreas
- Kidney / Ureters / Bladder / Prostate / genitals (Urology)
- Ovaries + Uterus/cervix (Gynaecology)
- Blood vessels
- Muscles, connective tissue, nerves, bones (Vascular, Orthopaedics)
Women have a Uterus, 2 Ovaries, Cervix & Vagina
History
Examination
Investigation
Management

Danger Response?

AIRWAY  BREATHING  CIRCULATION  DISABILITY  EXPOSURE
Our patient is still at home

People comment on weight loss
Starts to notice altered bowl habits ...
...loose/harder..

Thinks there was blood in stool- not sure...
List the organs of the gastrointestinal tract -top to bottom!
Organs

- Mouth- Oropharynx
- Oesophagus
- Stomach
- Duodenum, Jejunum, Ileum, Caecum
- Ascending Colon, Transverse + Descending
- Sigmoid, Rectum + Anus
GP visit

Wt loss of 1 stone in 10 weeks
Says he’s more breathless + tired
Initial Investigations
  Full blood Count
  Urea + Electrolytes

GP is concerned- refers to hospital
Full Blood Count

What is a Full Blood Count?
What is wrong with the FBC
<table>
<thead>
<tr>
<th><strong>Full Blood Count</strong></th>
<th><strong>result</strong></th>
<th><strong>normal range</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Haemoglobin</td>
<td>85g/L</td>
<td>man 130-180 g/L</td>
</tr>
<tr>
<td></td>
<td></td>
<td>woman 115-165 g/L</td>
</tr>
<tr>
<td>MCV</td>
<td>65</td>
<td>77 - 95 fL</td>
</tr>
<tr>
<td>White Cell count</td>
<td>8.5</td>
<td>2 - 7.5 x 10⁹/L</td>
</tr>
<tr>
<td>Neutrophils</td>
<td></td>
<td>1.2 -3.6 x 10⁹/L</td>
</tr>
<tr>
<td>Lymphocytes</td>
<td></td>
<td>0.2 - 1.0 x 10⁹/L</td>
</tr>
<tr>
<td>Monocytes</td>
<td></td>
<td>0 - 0.4 x 10⁹/L</td>
</tr>
<tr>
<td>Eosinophils</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basophils</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Platelets</td>
<td>167</td>
<td>150-400 x10⁹/L</td>
</tr>
</tbody>
</table>
SBA about Anaemia
MCV units femtoliters (fL, or $10^{-15}$L) mean corpuscular volume

An approach to Anaemia diagnosis

Dr Rakesh Popat UCL
Mechanism of Anaemia

- Reduced production of red cells/haemoglobin in the bone marrow
- Loss of blood from the body
- Reduced survival of red cells in the circulation
- Pooling of red cells in a very large spleen
Low mean corpuscular volume

Microcytic Anaemia

• Common causes of a microcytic anaemia
  – Defect in haem synthesis
    • Iron deficiency  Eg chronic blood loss
    • Anaemia of chronic disease
  – Defect in globin synthesis (thalassaemia)
    • Defect in α chain synthesis (α thalassaemia)
    • Defect in β chain synthesis (β thalassaemia)
Normocytic Anaemia = normal cell size

Failure of Red Cell Formation
  Anaemia of Chronic Disease
  Marrow suppression / failure /Infiltration/

Increased red cell loss/destruction
  Acute blood loss- initially
  Hypersplenism
  Hemolytic disorders

Congenital conditions
  • Hemoglobinopathies eg HbS
  • Red Cell Membrane eg Hereditary spherocytosis
  • Red Cell Enzyme eg G-6-PD
Macrocytic anaemia causes:

- Vitamin B12 or folic acid deficiency
- Use of drugs interfering with DNA synthesis
- Liver disease and ethanol toxicity
- Myelodysplasia
- Increase reticulocytes
  - 20% larger than mature red cells
  - Seen in Blood loss- often Reticulocytes on a blood film
  - Haemolytic anaemia
Hospital Tests

- Sees Gastro-Intestinal Medicine Doctor
  - Weight loss
  - Altered bowl habit
  - Microcytic anaemia
  - ? Saw blood in stool?
- Decides to do endoscopy
  - Lower GI endoscopy
    = Colonoscopy
  - Upper GI Endoscopy
    = Oesophago-Gastro-Duodenoscopy = OGD
Video
What are the lines Valvulae conniventes, Plicae circulares or Haustra
Small vs Large bowl

Small bowel
Bowel markings often continuous across the bowel
– the *Valvulae Conniventes / Plicae Circulares*

Central Position

Large bowel
Bowel markings or folds do not fully cross the lumen of the bowel - the *haustra*

Peripheral Position
Anaesthetists are fab
Picture of Tumour
SBA Tumours
### Types of Tumours

#### Classification of Neoplasms

<table>
<thead>
<tr>
<th>Benign</th>
<th>Malignant</th>
</tr>
</thead>
<tbody>
<tr>
<td>- No local invasion</td>
<td>- Local invasion by definition</td>
</tr>
<tr>
<td>- No potential for metastasis</td>
<td>- Potential for metastasis by definition</td>
</tr>
<tr>
<td>- Slow rate of growth</td>
<td>- Variable growth rate</td>
</tr>
<tr>
<td>- Well-differentiated</td>
<td>- Variable degree of differentiation</td>
</tr>
</tbody>
</table>
Malignant - microscopy

• Pleomorphic - variation in cell size and shape

• Mitotic activity - Increased in more malignant tumors and often abnormal in shape

• Necrosis – tumour cells dying when they outgrow their blood supply. Common in fast growing tumours
Picture of Theatre- tumour!
Cancer Diagnosis- Investigations

Imaging eg USS, XR, CT, MRI

Microscopy

Immunohistochemistry

Genetics

Molecular techniques

• Cytology – cells shed from tumour
e.g sputum, urine, cervical smear, fluid or aspirated
(‘FNA’= fine needle aspiration)

• Histology – a sample of tissue itself
  Biopsy – percutaneous or endoscopically
  Resection at surgery – formal grading / stage
Sees Surgeon

- History, Examination etc
- Discuss in blood transfusion

- Surgery, Chemo, Radiotherapy
  +/− immune (mAb) +/− hormonal
- MDT discussion = Multi Disciplinary Team
- Discuss + has blood transfusion
- Consent for surgery
Ethics

Everyday practice

1: Consent

2: Confidentiality

Thanks UCL Medical Ethics and Law Unit
Ethics 1: Consent

Thanks UCL Medical Ethics and Law Unit
SBA Ethics
Capacity

- Understand information
- Retain information
- Weigh information and reach a conclusion
- Communicate the decision
Requirements for valid consent

The patient must have the *capacity to consent*
- be competent

The consent must be *freely given*
- voluntary & no coercion

The person consenting must be *suitably informed*
- be adequately informed
Do we need consent if...

It’s an emergency and they’re unconscious?
We discover something extra during surgery?
Consent Picture
Consent Picture
Ethics 2: Confidentiality

Allows patients to seek medical help or to give doctors the information we need to provide good care.

But sharing appropriate information is essential to the efficient provision of safe, effective care

GMC: “.........information about patients will be held in confidence by their doctors”.
“You must be prepared to explain and justify your decisions and actions. “

More information at Confidentiality GMC 2013
Ethics 2: Confidentiality

? 

• How can we breach it?
Ethics 2: Confidentiality

- Confidentiality vs need to unload after stress
- Is it OK to talk to friends / partner / parents?
- Is it OK to write on Facebook?
- Is it OK to Tweet?

- Be careful...

More information at Confidentiality GMC 2013
Confidentiality: Mobile Phone
Ethics 2: Confidentiality

• No features identifying a patient
• Be careful about where you work - relative could identify a patient
• No features identifying a colleague

• Be very careful
  – on social media - effectively in public domain
  – in public – lifts, on phone etc

More information at www.gmc-uk.org
Back to our patient....
Sees Anaesthetist Preassessment

- Takes bloods
- Electocardiograph ECG
- Discusses Transfusion
- Discusses Risk

<table>
<thead>
<tr>
<th>History</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examination</td>
</tr>
<tr>
<td>Investigation</td>
</tr>
<tr>
<td>Treatment</td>
</tr>
</tbody>
</table>
SBA ECG basics
Conduction Speed through the Heart

- **P Wave**: SA Node
- **QRS Complex**: AV Node, Bundle Branches
- **T Wave**: Purkinje Fibers, Ventricular Muscle

- **Atrial Depolarisation**
- **Ventricular Depolarisation**
- **Ventricular Repolarisation**
- **Atrial repolarisation**
ECG

• ECG is electrical activity of heart
• Measured by leads on chest normally
• 12 ‘leads’ =
  – 6 chest leads are physical electrical leads
  – 6 limb leads are electrically computed leads
6 Chest leads

Six positive electrodes placed over specific regions of the heart

Cardiovascular Physiology Concepts. www.cvphysiology.com Richard E. Klabunde, PhD

Dr Jonathan Fry
ECG

• 12 ‘leads’ =
  – 6 chest leads are physical electrical leads
  – 6 limb leads are electrically computed leads
Limb leads- physical placement

6 limb leads are electrically computed from these 4 physical leads.
‘6 Limb leads’
Dr Jonathan Fry
Normal

Date taken
Clinical Info
Speed and Amplitude

First Name
Second name
Date of birth
Hospital Number

10 mm/mV 25 mm/s

aVR
V1
V4

aVL
V2
V5

aVF
V3
V6

Rhythm [II] 10 mm/mV
## ECG Interpretation

<table>
<thead>
<tr>
<th>Rate</th>
<th>P wave</th>
<th>Put it all together and summarise findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rhythm</td>
<td>PR interval</td>
<td></td>
</tr>
<tr>
<td>Axis</td>
<td>QRS complex</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ST segment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>T wave</td>
<td></td>
</tr>
<tr>
<td></td>
<td>QT interval</td>
<td></td>
</tr>
</tbody>
</table>

### Clinical Info
- Date taken
- Speed and Amplitude

### Patient Information
- First Name
- Second name
- Date of birth
- Hospital Number

---

Dr Jonathan Fry
Normal
Our Patient’s ECG

RHYTHM STRIP: II
25 mm/sec; 1 cm/mV

Date taken
Clinical Info
Speed and Amplitude
rhythm traces

• Traces of Atrial Fibrillation or normal?

• Problems with AF
Random SBA on Autonomic Physiology
SBA Autonomic Physiology
Our patient ...discusses Transfusion

Why discuss?
• Patients need to know what’s going to happen
• Side effects
• Some people don’t want eg Jehovah’s Witness

Must discuss
Discusses Transfusion

Side effects
Side effects of blood products

• Infections
  – Hepatitis BC, HIV, other viruses

• Immune
  – Major ABO reactions
  – Other immune

• Iron overload- RBC

• Other side effects-
  – cold, coagulation, low Ca\(^{++}\), high K\(^+\)
Whole Blood

White Cells

Red Cells

Platelets

Plasma

FFP (fresh frozen plasma)

Cryoprecipitate

Plasma for fractionation (not UK) (pools of thousands of donors)

albumin
factor VIII: IX immunoglobulins anti-D etc

Dr John-Paul Westwood
‘Blood’
Packed Red Cells

- Haemoglobin
- $O_2$ carriage

Platelets
- Low Plt number
- Abnormal Plt Fn

Fresh Frozen Plasma
- Clotting Factors

‘Cryoprecipitate’

FFP

Fibrinogen
### Table of Red Cell Antigens

<table>
<thead>
<tr>
<th></th>
<th>A Antibodies</th>
<th>B Antibodies</th>
<th>A + B Antibodies</th>
<th>Plasma</th>
<th>Frequency UK</th>
</tr>
</thead>
<tbody>
<tr>
<td>O Cells</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A Cells</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B Cells</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AB Cells</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Blood Grouping

80+\% Rhesus D positive- have D antigen on cells = Rhesus Factor
80\% of Rhesus –ve will develop antibodies if have Rh+ transfusion

Which is the ‘Universal donor’ ?

Which is the ‘Universal recipient’ ?

Many other red cell antigen groups eg Kell, Lewis, Duffy, Kidd ++

NBTS UK data  www.blood.co.uk
<table>
<thead>
<tr>
<th></th>
<th>A Antibodies</th>
<th>B Antibodies</th>
<th>A + B Antibodies</th>
<th>Plasma</th>
<th>Frequency UK</th>
</tr>
</thead>
<tbody>
<tr>
<td>O Cells</td>
<td></td>
<td></td>
<td>yes</td>
<td>AB Ab</td>
<td>47%</td>
</tr>
<tr>
<td>A Cells</td>
<td></td>
<td>yes</td>
<td></td>
<td>B Ab</td>
<td>39%</td>
</tr>
<tr>
<td>B Cells</td>
<td>yes</td>
<td></td>
<td></td>
<td>A Ab</td>
<td>10%</td>
</tr>
<tr>
<td>AB Cells</td>
<td></td>
<td></td>
<td>No Ab</td>
<td></td>
<td>4%</td>
</tr>
</tbody>
</table>

80+% Rhesus D positive- have D antigen on cells = Rhesus Factor 80% of Rhesus –ve will develop antibodies if have Rh+ transfusion

Which is the ‘Universal donor’ **O**

Which is the ‘Universal recipient’ **AB**

Many other red cell antigen groups eg Kell, Lewis, Duffy, Kidd ++

NBTS UK data  www.blood.co.uk
Genetics of ABO

Our patient is group O

What blood group might his/her parents been?

<table>
<thead>
<tr>
<th>Blood Group A</th>
<th>Genetics AO or AA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood Group B</td>
<td>Genetics BO or BB</td>
</tr>
<tr>
<td>Group AB</td>
<td>Genetics AB</td>
</tr>
<tr>
<td>Group O</td>
<td>Genetics 00</td>
</tr>
</tbody>
</table>
Genetics of ABO

Parent 1
Genetics AO or BO
or OO

Parent 2
Genetics AO or BO
or OO

Patient Blood group 0
Genetics 00
Transfusion Errors!

• Clinical and Lab Errors

• 2013 deaths
  – 12 after ABO incompatible Transfusion
    • 5 clinical, 7 Laboratory
  – 22 deaths due to other causes

• 4 parts to a patients Identity
  – Blood / CXR / ECG / patient notes / consent etc etc

Boring

......but v important!!

SHOT 2013 report
Our Patient has surgery...

- Colectomy = col.....ectomy
  - Right / left / hemi- / total
- What are you going to do with bowl end?!
- Stoma vs connect up
Surgery is a big deal

- Needs Anaesthesia
  - “will I wake up?”
  - “will I wake up during the surgery?” = awareness
- Patients often have complications – minor / major
- Pain after / can’t work / do activities
- May never recover same function
- May die

- Sympathetic response, physical challenges, inflammation
<table>
<thead>
<tr>
<th>Procedure</th>
<th>Mortality %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large intestine; complex major procedure</td>
<td>22.4</td>
</tr>
<tr>
<td>General abdominal; major &gt; 69 years</td>
<td>15.8</td>
</tr>
<tr>
<td>Complex hip or knee joint revision</td>
<td>11.6</td>
</tr>
<tr>
<td>Elective abdominal vascular surgery</td>
<td>7.4</td>
</tr>
<tr>
<td>Coronary Artery Bypass Graft only</td>
<td>1.5</td>
</tr>
<tr>
<td>Primary hip replacement</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Pearce 2006
SORT Surgery Risk
SORT Surgery Risk
SBA Allergy
During surgery

- Cardiovascular challenges – equations
- Fluid challenge
- Cardiac Output measurement
SBA CVS
Equation 1

Mean Arterial Pressure = Cardiac Output \times \text{Systemic Vascular Resistance}

\[
\text{MAP} - \text{CVP} = \text{CO} \times \text{SVR}
\]

MAP & CO measured
SVR calculated- not measured directly

‘Cardiogenic’ = of the heart
‘Vaso...Veno ...dilation/constriction’
Equasion 1 implication

Mean Arterial Pressure = CO \times SVR

2 ways to alter blood pressure

‘Pathology’ of low blood pressure

Myocardium- muscle
Rhythm- rate
Valves - forward flow
Oxygenated blood coming back to the heart = normal venous return
Relax + fill properly

SV \times HR

CO Cardiac causes or changes in blood volume
SVR Sepsis and Anaphylaxis
Equasion 2

The amount of Oxygen leaving the heart .....in the blood each minute =
called Oxygen Delivery = \( \text{DO}_2 \)

= amount of blood pumped each minute
\( \times \) the amount of oxygen in the blood

\( \frac{\text{SV} \times \text{HR}}{\text{CO} \times \text{Oxygen content of blood}} \)

Haemoglobin concentration

\( \% \text{HbO}_2 \) saturation
Equasion 2 Implications

Oxygen Delivery $\text{DO}_2$

$\text{DO}_2 = \text{CO} \times \text{Oxygen content}$

reduced $\text{DO}_2$

↓ $\text{CO}$  SV x HR  Measure SV and HR
↓ Hb $\text{O}_2$% saturation
↓ Haemoglobin

---

Blood Gas Values

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Reference Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>7.380</td>
<td>[7.350 - 7.450]</td>
</tr>
<tr>
<td>$p\text{CO}_2$</td>
<td>57.3 mmHg</td>
<td>[35.0 - 45.0]</td>
</tr>
<tr>
<td>$p\text{O}_2$</td>
<td>116 mmHg</td>
<td>[75.0 - 100]</td>
</tr>
</tbody>
</table>

Acid Base Status

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Reference Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>cHCO$_3$</td>
<td>23.3 mmol/L</td>
<td>[-3.0 - 3.0]</td>
</tr>
<tr>
<td>cBase(B)</td>
<td>-1.3 mmol/L</td>
<td>[-3.0 - 3.0]</td>
</tr>
</tbody>
</table>

Electrolyte Values

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Reference Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>cK$^+$</td>
<td>4.4 mmol/L</td>
<td>[3.4 - 5.5]</td>
</tr>
<tr>
<td>cNa$^+$</td>
<td>137 mmol/L</td>
<td>[136 - 146]</td>
</tr>
<tr>
<td>cCa$^2+$</td>
<td>1.02 mmol/L</td>
<td>[1.15 - 1.30]</td>
</tr>
<tr>
<td>cCl$^-$</td>
<td>0.96 mmol/L</td>
<td>[0.94 - 1.07]</td>
</tr>
</tbody>
</table>

Metabolite Values

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Reference Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>cGlucose</td>
<td>9.0 mmol/L</td>
<td>[3.9 - 6.8]</td>
</tr>
<tr>
<td>cLac</td>
<td>3.1 mmol/L</td>
<td>[0.5 - 2.0]</td>
</tr>
</tbody>
</table>

Oxygen Status

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Reference Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hb</td>
<td>138 g/L</td>
<td>[130 - 160]</td>
</tr>
<tr>
<td>sO$_2$</td>
<td>97.7%</td>
<td>[95.0 - 100.0]</td>
</tr>
<tr>
<td>$p\text{SO}_2$</td>
<td>30.22 mmHg</td>
<td></td>
</tr>
<tr>
<td>$p\text{O}<em>2(a/A)</em>{\text{O}}$</td>
<td>75.8%</td>
<td></td>
</tr>
<tr>
<td>$\text{FMeHb}$</td>
<td>1.1%</td>
<td>[0.0 - 1.5]</td>
</tr>
<tr>
<td>$\text{FCO}_2$Hb</td>
<td>0.8%</td>
<td>[0.0 - 1.5]</td>
</tr>
<tr>
<td>$p\text{SO}_2(\text{st})$</td>
<td>26.84 mmHg</td>
<td></td>
</tr>
<tr>
<td>$F\text{ShUnO}_{2}$</td>
<td>6.2%</td>
<td></td>
</tr>
<tr>
<td>$\text{FO}_2$Hb</td>
<td>95.8%</td>
<td>[20.0 - 100.0]</td>
</tr>
<tr>
<td>Hct</td>
<td>42.2%</td>
<td></td>
</tr>
</tbody>
</table>

Notes
Doppler Monitor
Fluid Challenge
Doppler Monitor

- ....after Fluid challenge: Normal increase in Stroke Volume
Extrapolations of the Frank-Starling relationship is....?

SBA on Curves – which one?

• B blockers
• Increased inotropy
• Heart failure
• Response to bleeding
• Vasodilation
• Sepsis
Ways to measure Cardiac output

Oesophageal Doppler Monitor
Ways to measure Cardiac output

Oesophageal Doppler Monitor
Pulmonary artery catheter
Ways to measure Cardiac output

Oesophageal Doppler Monitor
Pulmonary artery catheter
ECHO cardiography
– only one gives structure & function
Ways to measure Cardiac output

Oesophageal Doppler Monitor
Pulmonary artery catheter
ECHO cardiography
– only one gives structure & function
Dye dilution LiDCO:
Pulse contour analysis: LiDCO and PiCCO
SBA Vessels
Planned after surgery

Pain relief = analgesia
Fluid therapy – if they can’t drink
Deep Vein Thrombosis prevention = DVT prophylaxis
Nausea and vomiting
Anti-constipation drugs
Exercise/ Mobilise / Eat and drink
Virchow’s Triad

- Stasis
- Venous
- Hypercoagulability
- Thrombosis
- Arterial
- Vessel wall injury
- Thrombosis
What are the risk factors for VTE?

Risk factors:
- Significantly ↓ mobility
- Surgery
- Certain medical conditions
- Abnormal clotting conditions
- Active cancer
- Dehydration
- Obesity
- History of VTE
- HRT or The ‘pill’
- Pregnancy

(list not exhaustive)
Our Patient

- Woken up after surgery
- Pain is OK, breathing OK
Our Patient; Day 2 post op

• Notices harder to breathe
• Can’t finish speaking his/her sentences
• Nurses: respiratory rate 24 /min
• Nurses: Oxygen Saturation \( \text{SaO}_2 \) 88 %

• What could cause this?
Postoperative Complication 1

Shortness of Breath

- Hospital acquired pneumonia
- Atelectasis = areas of lung collapse
- Pulmonary Embolism
- Pulmonary Oedema = Cardiac Failure
- Pneumothorax
On Examination

Cardiovascular Feels warm to touch. HS I + II + O.

Respiratory
Inspection
Palpation
Percussion
Auscultation

Neurological
Alert, orientated, GCS 15/15

Peripheral vascular
All peripheral pulses palpable

Abdominal
Inspection
Palpation
Percussion
Auscultation

History
Examination
Investigation
Treatment
What you going to do?

Urine?
Bloods?
ECG?
X-Ray: Chest X-Ray?
Special investigations: ABG, sputum culture, blood cultures

Mnemonic: UBEXS
SBA CVS
Postoperative Complication 1

• Pneumonia = lower Respiratory Tract Infection

• Community vs Hospital Acquired

• Infections causing shortness of breath in UK
  – Bacterial
  – Viral
  – Fungal
Infections

Bacteria
Prokaryotes – no nucleus or organelles
Gram stain +/- peptidoglycan
Antibiotics useful
Bacilli/rod Cocci Spirochates
Release toxins

Virus
Small + Inert
Dependence on host
DNA or RNA

Fungi
Eukaryotes, Common in Environment
1. Yeasts (unicellular),
2. Moulds (filamentous)
3. Dimorphic- either form

Protozoa
Eukaryote, Unicellular
Complex life cycles
No vaccines
Usually good treatment/prevention

Helminths
Eukaryotes, complex, multicellular
Complex lifestyle
Tapeworms (cestodes)
Flukes (trematodes)
Round worms (nematodes)
Common Bacterial causes: Community Acquired Pneumonia

- **Extracellular organisms:**
  - *Streptococcus pneumoniae* (>50%)
  - *Haemophilus influenzae* (10%)

- **Intracellular organisms ("atypicals"):**
  - *Mycoplasma pneumoniae* (10%)
  - *Legionella pneumophila* (2%)
  - *Chlamydia pneumoniae* and *C. psitacci*
  - *Coxiella burnetti*

- **Tuberculosis**
Common Bacterial causes of Hospital Acquired pneumonia

- *Pseudomonas aeruginosa*
- *Klebsiella species*
- *Escherichia coli*
- *Acinetobacter species*
- *Staphylococcus aureus*
- *Streptococcus pneumoniae*
- *Haemophilus influenzae*

Gram Negative more common
Staph Aureus more common

ATS 2004
## Gram Positive vs Gram Negative

<table>
<thead>
<tr>
<th></th>
<th>Gram Positive</th>
<th>Gram Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell Wall thickness</td>
<td>20-80 nm</td>
<td>10 nm</td>
</tr>
<tr>
<td>Number of layers in wall</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Peptidoglycan</td>
<td>high</td>
<td>low</td>
</tr>
<tr>
<td>Lipid/Lipoprotein %</td>
<td>low</td>
<td>high</td>
</tr>
<tr>
<td>Releases</td>
<td>Sometime exotoxin</td>
<td>Endotoxin = lipopolysaccharide</td>
</tr>
<tr>
<td>Lipotechtoic acid</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Penicillin Sensitive</td>
<td>yes</td>
<td>less</td>
</tr>
</tbody>
</table>

Thanks Dr TV Rao
**BACTERIA SHAPES**

### SPHERES (COCCI)
- Diplococci (Streptococcus pneumoniae)
- Staphylococci (Staphylococcus aureus)
- Tetrad
- Chain of bacilli (Bacillus anthracis)

### RODS (BACILLI)
- Streptococci (Streptococcus pyogenes)
- Flagellate rods (Salmonella typhi)
- Spore-former (Clostridium botulinum)
- Spirochaetes (Treponema pallidum)

### SPIRALS
- Vibrios (Vibrio cholerae)
- Spirilla (Helicobacter pylori)
How Antibiotics Work

- **Folate Synthesis**
  - Sulphonamides
  - Trimethoprim

- **DNA Synthesis**
  - Metronidazole
  - Quinolones

- **DNA Gyrase**
  - Rifampicin

- **RNA Polymerase**
  - Rifampicin

- **Cell Wall Synthesis**
  - D-cycloserine
  - Vancomycin
  - Bacitracin
  - Penicillins
  - Cephalosporins
  - Cephamycins

- **Cell Wall Integrity**
  - β-lactamases

- **Transcription**
  - Cell wall
  - DNA
  - Replication

- **Translation**
  - Protein Synthesis (50s inhibitors)
  - Erythromycin
  - Chloramphenicol
  - Lincomycin

- **Cytoplasmic Membrane**
  - Phospholipid Membranes
  - Polymyxins

TutorVista.com
Antibiotic resistance

Health Protection Agency 2004-2008/NAO  Cefotaxime resistance
Bacterial classification

What when how
Viral classification

Possible structural components:
- Virus proteins
- Envelope from host cell
- Nucleoprotein
- Capsid forming virus structure

- ds DNA
  - Herpesvirus
  - Pox virus
  - Adenovirus
  - Hepadnavirus

- ss DNA
  - Parovirus

- +ss RNA
  - Picornaviridae
    - Calicivirus
    - Togavirus & Flavivirus
    - Coronavirus

- -ss RNA
  - Paramyxoviridae
  - Orthomyxoviridae
  - Arenaviridae
  - Rhabdoviridae

- +ss RNA
  - Retroviridae (HIV)

What when how
Postoperative Complication 2

Day 3
Our patient’s shortness of breath worsens
Someone takes an ‘arterial blood gas’

Blood from an artery
  blood from lungs- left heart – aorta....
  radial artery
Arterial blood gas
Lots of information!

- **pH**: pH - a measure of acidity / alkilinity
- **pCO₂**: Respiratory- ventilation
- **pO₂**: Metabolic
- **HCO₃⁻**: Acid base
- **BEx**: Oxygenation
- **Lactate**: Other measurements
- **Hb, Na⁺, K⁺ etc etc**: Other measurements
Arterial blood gas
Lots of information!

**pH**
- pH down: more H⁺
- pH up: less H⁺
- pH - H⁺ acid

**pCO₂**
- Respiratory- ventilation- breathing
  - CO₂ + H₂O ⇌ H₂CO₃ ⇌ H⁺ + HCO₃⁻

**HCO₃⁻**
- Metabolic= everything apart from CO₂
- = everything apart from lungs/ventilation
  - H₂CO₃ ⇌ H⁺ + HCO₃⁻
SBA Respiratory
ABG Picture
### Arterial blood gas

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>7.22</td>
<td>low Acid</td>
</tr>
<tr>
<td>pCO₂</td>
<td>4.5 kPa</td>
<td>normal</td>
</tr>
<tr>
<td>pO₂</td>
<td>7.8 kPa</td>
<td>low</td>
</tr>
<tr>
<td>HCO₃⁻</td>
<td>16.7 mmol/L</td>
<td>low</td>
</tr>
<tr>
<td>BE</td>
<td>-8.7</td>
<td>low</td>
</tr>
<tr>
<td>Lactate</td>
<td>4.8 mmol/L</td>
<td>high</td>
</tr>
</tbody>
</table>
Arterial blood gas

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>7.52</td>
<td>high alkaline</td>
</tr>
<tr>
<td>pCO₂</td>
<td>2.5 kPa</td>
<td>low</td>
</tr>
<tr>
<td>pO₂</td>
<td>7.8 kPa</td>
<td>low</td>
</tr>
<tr>
<td>HCO₃⁻</td>
<td>24 mmol/L</td>
<td>normal</td>
</tr>
<tr>
<td>BE</td>
<td>-0.5</td>
<td>normal</td>
</tr>
<tr>
<td>Lactate</td>
<td>0.8 mmol/L</td>
<td>normal</td>
</tr>
</tbody>
</table>
• Our patient is given oxygen.....
ABG Picture
‘DRABC’

Danger?
Response
Airway
Breathing
Circulation
Disability
ABG Picture
Respiratory Failure

= low Oxygen levels breathing room air
= low partial pressure Oxygen = PaO₂ < 8 kPa
Normal is ~10-13 kPa
= both ie type 1 and 2 respiratory Failure

Difference is

• Type 2 – failure of ‘ventilation’ as well
  = failure to move air in and out
  = can’t get CO₂ out of the body
  = so CO₂ builds up in the body – raised blood levels
Respiratory Failure

• Type 1 $\text{PaO}_2 < 8\text{kPa}$  \hspace{1cm} \text{PaCO}_2 \text{ normal/low}
• Type 2 $\text{PaO}_2 < 8\text{kPa}$  \hspace{1cm} \text{PaCO}_2 \text{ raised}

Assumption - breathing air

If $\text{PaO}_2 > 13\text{kPa}$ – must be breathing extra oxygen!
### Our Patient’s arterial blood gas

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>7.42</td>
<td>normal</td>
</tr>
<tr>
<td>pCO₂</td>
<td>4.5 kPa</td>
<td>normal</td>
</tr>
<tr>
<td>pO₂</td>
<td>7.8 kPa</td>
<td>low</td>
</tr>
<tr>
<td>HCO₃⁻</td>
<td>21.7 mmol/L</td>
<td>low/normal</td>
</tr>
<tr>
<td>BE</td>
<td>-2.7</td>
<td>low</td>
</tr>
<tr>
<td>Lactate</td>
<td>0.8 mmol/L</td>
<td>normal</td>
</tr>
</tbody>
</table>
Causes of type 1 respiratory failure

Anything that interferes with Oxygen Transfer ie Ventilation or Perfusion (regional V/Q)

- Pneumonia
- Pulmonary Embolus
- Pneumothorax
- Asthma
- Pulmonary Oedema
- Interstitial Lung Disease
- Pulmonary Artery Hypertension
- etc
Causes of type 2 respiratory failure
Anything that interferes with Ventilation

– Brain
  • Head Injury, Poisons, Drugs, Anaesthesia

– Spinal, Nervous, neuro-muscular junction
  • Guillain-Barré, Phrenic injury, NMJ blockers, spinal cord trauma, Myaesthenia gravis

– Muscular
  • Fatigue, (PE), Hypovolaemia

– Chest Wall / Cavity
  • Raised abdominal pressure, (pneumothorax), effusion, rib fracture

– Airways disease
  • Asthma, COPD, Upper airway Obstruction
Normal Chest Radiograph
<table>
<thead>
<tr>
<th>First Name</th>
<th>Second name</th>
<th>Date of birth</th>
<th>Hospital Number</th>
</tr>
</thead>
</table>
CXR
Our patient

- Gone through a lot
- Home day 12 after her/his hemicolecctomy
We’ve covered

• Abdominal anatomy
• Cancer
• Chest X Ray
• Electro Cardio Graphs ECG
• Blood Gas analysis/Hypoxia
• Blood products
• Anaemia
• Ethics –consent and confidentiality
• Infections
• Pneumonia, Pneumothorax
Thank you for the slides from

Dr Rakesh Popat UCL Cancer Institute & UCLH
Dr John-Paul Westwood, Consultant Haematologist, UCLH
Dr Jonathen Fry, UCL and Royal Free Hospital
Dr Hannah Cohen, Haematologist, UCLH and UCL
Mr Peter Gogalniceanu, UCL

Google Images
Break CXR

- Different chest x rays.. What is..
- Normal including names, dob, no
- PPM
- Air under diaghram
- ECG dots
- CVP
- Intubated
- Lobar consolidation
How to Read A Chest X-Ray

A: Address: name, date of birth, date of x-ray
A: Adequacy: rotation, penetration, inspiration
A: Airway

B: Breathing: lung fields
B: Bones
B: Breast shadows

C: Cardiac: mediastinum

D: Diaphragm: include above and below

E: Everything else

F: Foreign objects