Section 1 Medicine

Chapter 1.1

Bone, joint and connective tissue

1.1.1. Rheumatoid arthritis – Sarah F Bell

You are on the ward reviewing a 55-year-old female patient who is on your list for a total knee replacement tomorrow. She is keen to tell you that she has severe rheumatoid arthritis that is particularly bad in her hands.

What can you tell me about this condition?

The examiners will be looking for some background medical knowledge to start with.

Rheumatoid arthritis is a systemic chronic inflammatory disease that affects 1 to 2% of the UK population. It is more prevalent in women, affecting females three times more than men. The onset is generally between 30 and 55 years. The exact cause of the condition is unknown, but it is thought to involve an autoimmune process. About 70% of cases are positive for HLA-DR4, and 80% of sufferers are seropositive for rheumatoid factor.

How does the arthritis present?

The patient develops a symmetrical polyarthritis. This may be of varying extent and severity. Rheumatoid arthritis tends to affect the hands, feet, knees, elbows, shoulders and neck.

What is the pathological process that occurs?

The pathological process involves synovitis of joints and tendon sheaths. Loss of articular cartilage and erosion of juxta-articular bone leads to joint destruction.

What is Still's disease?

This is the most common childhood form of the disease. It can be particularly debilitating.

Going back to our case, what might be your concerns regarding anaesthetising a woman with rheumatoid arthritis?

I would want to fully assess the extent of the disease since rheumatoid arthritis is a multi-system condition that can have a number of implications for the anaesthetist. I would

Dr. Podcast Scripts for the Final FRCA, ed. Rebecca A. Leslie, Emily K. Johnson, Gary Thomas and Alexander P. L. Goodwin. Published by Cambridge University Press.

be particularly concerned about any airway, respiratory, cardiac, musculoskeletal or haematological problems. I would need to review her drug therapy since this may also influence the anaesthetic.

If the woman had not told you that she had been diagnosed with rheumatoid arthritis, what might be some of the symptoms of the condition?

Start with the musculoskeletal symptoms and then move on to the extra-articular symptoms if the examiner will let you.

Rheumatoid arthritis generally presents with **symmetrical** joint problems. Patients experience **pain** and **stiffness**. This is worse in the morning and improves with activity. The symptoms may occur as flare ups interspersed with good periods. The patient may have noticed progressive **joint deformities**, particularly affecting the hands. The patient may also describe fatigue, weight loss and low mood. About half of sufferers have extra-articular complications, which can involve the airway, respiratory, cardiovascular, neurological, renal and haematological systems.

So, what signs might you observe in the musculoskeletal system?

The patient may have hand or feet signs such as ulnar deviation, boutonniere or swan neck deformities and Z-shaped thumbs. Subcutaneous nodules might be visible.

What would you ask the woman in your history?

I would take a general and a specific history.

In the specific history I would be looking to ascertain how and when the rheumatoid arthritis was diagnosed. I would ask which joints were involved and to what extent. In particular I would discuss the range of neck and hand movement. I would also want to know about the drug treatments that the patient has tried and is currently taking.

So what can you tell me about rheumatoid neck disease?

The atlanto-axial joint may be affected in rheumatoid arthritis due to erosion of the transverse ligament and breakdown of the odontoid peg. About 25% of patients develop atlanto-axial subluxation. This can lead to acute spinal cord compression or compression of the vertebral arteries. Anterior axial subluxation is the most common type of subluxation and is worsened by neck flexion.

A fixed flexion deformity of the neck may also occur due to fusion of the spine. Osteoporosis is further worsened by steroid medication.

All of these problems may challenge the anaesthetist since manipulation of the airway may be difficult and should be kept to a minimum.

Let's go back to your history. Is there anything else that you might want to discuss regarding the musculoskeletal system?

I would want to ascertain whether either the temporomandibular or crycoarytenoid joints are affected since this might have implications for intubation and airway management. With

regards to the temporomandibular joint I would ask about mouth opening. The symptoms of crycoarytenoid involvement might include dyspnoea, hoarseness, stridor and, rarely, upper airway obstruction.

For a total knee replacement I would consider performing a spinal. I would therefore want to find out whether the patient had had any back involvement or operations. I would also ask whether they would be able to get into a suitable position for this technique to be performed.

What other body systems might you ask about and why?

The examiner is looking to test your knowledge of the multiple complications of this disease. If you list at least some of the systems at the start you will indicate that you are planning to talk about them and that you have a thorough grasp of the condition.

I would enquire about the respiratory, cardiovascular, haematological, renal and neurological systems.

With regards to the respiratory system I would be looking for any evidence of pulmonary fibrosis, vasculitis, pulmonary hypertension, pulmonary nodules and pleural effusions. Furthermore the drugs given for the arthritis might have had unwanted pulmonary effects such as fibrotic changes.

Rheumatoid disease can affect the cardiovascular system in a number of ways. The patient is at an increased risk of arteriosclerosis, myocardial infarction and stroke. Mitral valve disease is present in up to 5% of patients. Pericardial disease such as effusions and inflammation may occur. Cardiac conduction defects may also develop.

The haematological system can be affected by the development of anaemia of chronic disease. Sometimes the platelet count is elevated in association with the generalised inflammatory response during a flare up. A leucopenia may also be seen.

And what about the nervous system?

The patient might develop a peripheral neuropathy from the rheumatoid arthritis or the drugs given to modify the condition. It is important to discuss and document any neurological changes, especially if a regional or central neuraxial block is considered, or if the cervical spine needs to be manipulated.

You mentioned the renal system. Can you tell me anything about the changes that might occur?

The patient may develop renal amyloid or a vasculopathy from the rheumatoid arthritis. This might be identified as acute or chronic renal failure.

Can rheumatoid arthritis affect the liver?

Yes. Felty's syndrome occurs when the inflammatory mediators associated with rheumatoid arthritis cause nodular hepatocyte enlargement. This can be associated with splenomegaly and leucopenia.

What about the eyes and skin?

The sclera may be involved. Episcleritis is a feature of rheumatoid arthritis, as is dry eyes. It is therefore important to protect the eyes during general anaesthesia to reduce the risk of

corneal ulceration or abrasion. With regards to the skin, rheumatoid nodules are common. Steroids can cause thin, papery skin to develop which needs to be handled extremely carefully to avoid trauma.

Let's consider the drugs that this patient might be taking. Can you suggest any drugs and their unwanted side effects?

Remember not to forget painkillers and the immunosuppressant or disease modifying agents.

The patient might be taking regular non-steroidal anti-inflammatory medications for pain relief. These can cause renal impairment, gastrointestinal ulceration, reduced platelet function and exacerbation of asthma in susceptible individuals.

Azathioprine, methotrexate, gold and penicillamine are all used to suppress the immune system in patients with rheumatoid arthritis. These drugs can cause bone marrow suppression, lung toxicity, liver dysfunction, thrombocytopenia, anaemia and renal side effects.

Steroids are frequently given to patients with rheumatoid arthritis. They have many side effects including hypertension, diabetes, obesity, adrenal suppression, fragile skin, peptic ulcer disease and electrolyte changes.

Anti-cytokine agents can give flu-like symptoms and cause bone marrow suppression.

Having ascertained that this woman has developed hypertension and diabetes since taking regular steroid medication, you find that there are no other extra-articular features of rheumatoid disease. What further information would you want to know in you general history?

I would enquire about previous anaesthetics and whether she has a family history of any problems with an anaesthetic. I would then ask the woman about other medical conditions and go stepwise through the body systems. I would particularly focus on the blood pressure, diabetic control and the cardiovascular history. I would then talk about the medications that the woman was taking and ask whether she had any allergies. Finally I would discuss starvation history and ask about the woman's dentition.

What examination would you perform on this woman?

I would examine the cardiorespiratory, neurological and musculoskeletal systems. I would include a thorough airway assessment in my respiratory examination. I would also look at the condition of the patient's skin and assess their ability to use a patient-controlled anaesthesia (PCA) (i.e., if the disease causes significant pain or deformity of the hands).

How would you investigate this patient prior to surgery?

I would want to review blood tests and an electrocardiogram (ECG) at a minimum. With regard to the blood tests, I would check the full blood count, renal function, electrolytes, liver function and ensure that a valid group and save were available. If I had identified features of respiratory disease in my history or examination I might request a chest X-ray or pulmonary function tests. If I suspected the rheumatoid disease might be affecting the neck I would

consider performing a neck X-ray in flexion and extension. If these were abnormal an MRI may be required. With regards to the airway, indirect laryngoscopy might be required if I suspected that the cricoarytenoid movement was impaired.

From your thorough assessment you have found that this 55-year-old woman has rheumatoid arthritis that appears to mainly affect her hands and knees. She has hypertension and diabetes. She takes 20 mg of prednisolone daily along with paracetamol and diclofenac when her arthritis is particularly bad. Her skin appears fragile.

What would be your preferred anaesthetic technique for this patient?

Try and be decisive about what you would want to do for this patient. The examiner wants to see that you have been in this position before and that you are confident of your abilities.

I would consider performing a spinal anaesthetic technique with local anaesthetic and intra-thecal opioid. In addition I would perform femoral and sciatic nerve blocks to provide additional post-operative analgesia. I would offer the patient intra-operative sedation. I would chart regular paracetamol and diclofenac with tramadol for breakthrough analgesia.

What are the potential problems with this technique?

The examiner is not trying to catch you out. They want to know that you can appreciate that there are pros and cons to every anaesthetic.

The spinal might be difficult to perform due to a number of factors. These include problems with patient positioning and altered anatomical landmarks. There is also a potential increased risk of infection, so aseptic technique is vital. The spinal with opioid poses the following risks: nerve damage, post-dural puncture headache, post-operative nausea and vomiting, respiratory depression and urinary retention. It is important that the nurses looking after the patient post-operatively are aware of these potential complications.

With regards to the peripheral nerve blocks these may also be challenging because of altered anatomical landmarks. I would use both a peripheral nerve stimulator and ultrasound to aid location of the nerves. Further risks include nerve damage, failure, intra-vascular injection and local anaesthetic toxicity.

What other anaesthetic techniques might be appropriate for this case?

The patient could have a general anaesthetic with peripheral nerve blockade and or morphine PCA. The general anaesthetic will require consideration of the need for intubation. The risk of aspiration should be weighed up against the potential difficulty of intubation and the risks associated with manipulation of the neck. There are many different ways of achieving an appropriate airway, which include an awake fibre-optic intubation, gas induction, IV induction, rapid sequence induction and insertion of either an endotracheal tube or a laryngeal mask airway (LMA).

A morphine PCA might also be appropriate for severe post-operative pain. Disadvantages of this include nausea and vomiting, respiratory depression and potential under-usage due to the patient being unable to manipulate the device due to their arthritis.

Are you aware of any recent publications regarding post-operative analgesia for total knee replacement?

A review article published in *Anaesthesia* in 2008 by the PROSPECT working group made a number of recommendations. They suggested that a general anaesthetic with a femoral nerve block or a spinal with opioid and a femoral nerve block were the anaesthetic options of choice for a total knee replacement, based on current evidence. They advised paracetamol, non-steroidal anti-inflammatory, residual femoral nerve block and opioid titrated to pain levels for post-operative analgesia. They were unable to advise regarding sciatic nerve blocks due to a lack of evidence.

How would you manage the steroid cover for this patient?

This question is relevant for any patient on steroids. Try and be as clear as possible.

Long-term steroid therapy suppresses the hypothalamic–pituitary–adrenal (HPA) axis. This axis is activated by major stress. It is therefore important to consider steroid replacement therapy for patients presenting for surgery to avoid peri-operative haemodynamic instability due to lack of cortisol.

Patients who take less than 10 mg of prednisolone daily do not require steroid replacement.

Patients who take more than 10 mg of prednisolone daily, or have done so within the past 3 months, should receive replacement therapy. For minor surgery this involves only 25 mg of hydrocortisone at induction. For moderate surgery the patient should receive their normal pre-operative dose of steroids followed by a further 25 mg of hydrocortisone at induction and 100 mg of hydrocortisone the next day. For major surgery the patient should again take their normal pre-operative dose of steroids. The anaesthetist should then give 25 mg of hydrocortisone at induction followed by 100 mg of hydrocortisone daily for 2 to 3 days or until normal gastrointestinal function has returned.

If this patient were taking a different steroid how would you convert the dose?

The 10 mg of prednisolone is equal to 1.5 mg of dexamethasone, 8 mg of methylprednislolone and 40 mg of hydrocortisone.

Further Reading

Fischer HB, Simanski CJ, Sharp C, et al. PROSPECT Working Group. A procedure-specific systematic review and consensus recommendations for postoperative analgesia following total knee arthroplasty. *Anaesthesia*. 2008; **63**(10): 1105–1123.

Fombon F, Thompson J. Anaesthesia for the adult patient with rheumatoid arthritis. *Continuing Education in Anaesthesia, Critical Care & Pain*. 2006; **6**(6): 235–239.

Joint Formulary Committee. *British National Formulary*. 58th edition. London: British Medical Association and Royal Pharmaceutical Society of Great Britain, 2009.

Nicholson G, Burrin JM, Hall GM. Peri-operative steroid supplementation. *Anaesthesia*. 1998; **53**: 1091–1104.

Section 1 Medicine

Chapter 1.2

Cardiovascular

1.2.1. Pre-operative assessment and management of patients with cardiac disease – Timothy JB Wood

You are in the pre-assessment clinic seeing a 66-year-old gentleman for a right total hip replacement. The pre-assessment nurse identified a systolic murmur, and the patient suffers from angina and is notably breathless on minimal exertion.

What are the important issues that you would like to explore in the history?

A structured approach is vital, ensuring you mention the routine history so that you don't miss anything out before focussing on the specific cardiac details.

I would introduce myself to the patient and ensure that I am talking to the correct patient and that he is expecting the operation that he is listed for. Then there are a number of general points in the history and some points specific to the cardiac history.

The general history would involve enquiry into:

- Previous general anaesthetics – what were they for and if they presented any problems
- Family history of problems with anaesthetics
- Any regular prescribed or non-prescribed medications
- Any allergies
- Any problems with his gastrointestinal system, particularly heartburn or reflux
- Starvation history
- Any joint problems other than his hips, especially focussing on his cervical spine flexion and extension
- Smoking history
- Alcohol intake.

The cardio-respiratory systems are inextricably linked and would form the focus of my attention in this patient.

Dr. Podcast Scripts for the Final FRCA, ed. Rebecca A. Leslie, Emily K. Johnson, Gary Thomas and Alexander P. L. Goodwin. Published by Cambridge University Press.

Specifically I would enquire about the following:

- Whether he suffered from hypertension, was on treatment for it and how well controlled it is.
- Had he ever had a myocardial infarction, and if so, what was done about it, had he had "clot busting" drugs, stents or surgery?
- Does he suffer from angina, and if so, when and how frequently does it tend to occur, and what does he do when it happens?
- How many pillows does he tend to sleep on and does he become breathless if he sleeps lying flat?
- Does he ever get palpitations or become aware of his heart beating in a funny rhythm?
- Has he suffered from sudden blackouts or loss of consciousness that had not been explained?
- Had he ever been told that he had a murmur?
- Does he suffer from asthma or chronic obstructive pulmonary disease (COPD) or any other problems with his breathing?
- How much exercise is he able to do before he is limited, and what is it that limits him? Through specific questioning it should be possible to calculate how many metabolic equivalents (METs) he is capable of.

You mentioned metabolic equivalents, can you tell me more about them and explain their significance?

Metabolic equivalents provide a means of approximating a patient's ability to increase their oxygen delivery to tissues in response to a physical demand. For example, 1 MET is based on the calculation of the basal oxygen requirement of a 40-year-old male of 70 kg at rest and this equates to 3.5 ml of oxygen per kilogram per minute. By enquiring about what the patient is able to do in their daily activities it is possible to estimate how many METs they can achieve.

- 3 METs is equal to light household work or walking 100 yards on the flat
- 4 METs is equal to climbing 2 flights of stairs
- 6 METs is equal to a short run
- Greater than 10 METs is equal to strenuous exercise.

The significance of this is that less than 4 METs is deemed to be a poor exercise tolerance and this group of patients has a higher rate of peri-operative and post-operative cardiovascular and neurological complications. However, often this system is limited due to patient's medical problems such as arthritis or visual impairment reducing their ability rather than cardiorespiratory problems.

What particular aspects in the history and examination would cause you to be particularly concerned about the murmur?

There are three cardinal features of aortic stenosis:

1. Angina
2. Syncope
3. Dyspnoea.

However, the severity of these symptoms do not correlate well with the degree of the aortic disease. Angina occurs due to the oxygen demand of hypertrophied myocardial muscle outstripping supply. Angina occurs in approximately two thirds of patients with critical aortic stenosis, about 50% of these patients will also have significant coronary artery disease. The precise mechanism of syncope is unclear, however, it would appear that, with a relatively fixed cardiac output, it is not possible to meet the increased demand placed on the cardiovascular system by standing or exercise. Thus such activities cause a fall in cerebral perfusion and a "blackout". Shortness of breath on exertion and orthopnoea and paroxysmal nocturnal dyspnoea and pulmonary oedema tend to be late symptoms and reflect pulmonary venous hypertension.

On examination, aortic stenosis classically has a slow rising and low volume pulse. However if aortic regurgitation is occurring simultaneously then the pulse pressure may be increased. A carotid and precordial thrill may be palpated, especially on leaning forward in expiration. The murmur is a harsh late peak systolic murmur heard best at the second right intercostal space. It radiates to the carotids. However these signs change as the severity of the aortic disease increases and the left ventricle fails, therefore reducing the flow through the valve and the murmur becomes less audible. Therefore an echocardiograph is required in order to assess the severity of a valve lesion.

You have mentioned echocardiography. How would you interpret the results of this investigation to form a risk level for different grades of aortic stenosis?

Echocardiography can be used to assess the anatomy of the aortic valve, grade the severity and assess the function of the left ventricle. The best indicator of aortic stenosis severity is the valve area.

- Mild stenosis is equal to an area of 1.2–1.8 cm^2
- Moderate stenosis is equal to an area of 0.8–1.2 cm^2
- Severe stenosis is equal to an area of 0.6–0.8 cm^2
- Critical stenosis is equal to an area of less than 0.6 cm^2.

Occasionally the pressure gradient across the valve is used for grading severity. However this can be misleading as in high output states such as simultaneous aortic stenosis and regurgitation the severity will be overestimated. More dangerously in low output states where there is a failing left ventricle the flow across the valve will be reduced and so will the gradient, thereby underestimating the disease severity.

Also, the left ventricular function will be graded as normal, mildly, moderately or severely impaired based on the subjective assessment of the echo images.

What blood investigations would you request?

The routine investigations would include:

- Full blood count to exclude any significant anaemia and any platelet or leucocyte abnormality
- Coagulation studies, especially if this patient is on warfarin, and determination of blood group

- Measurement of serum electrolytes, urea and creatinine as these are likely to be disturbed by medication that the patient is taking like diuretics
- Specific investigations may be required depending on the history, for example these may include liver function tests and B-type natriuretic peptide.

Can you tell me about B-type natriuretic peptide?

B-type natriuretic peptide is a hormone secreted by cardiac myocytes in response to mechanical stretch. It is increasingly being used as a biomarker for the diagnosis, management and prognostication of cardiac failure. It has been suggested that this marker could be used as a relatively non-invasive risk stratification tool, especially with a patient undergoing major or intermediate risk surgery who does not have the ability to function at greater than 4 METs without symptoms.

B-type natriuretic peptide levels can be elevated due to cardiac causes, pulmonary causes or other causes, for example renal or septic shock. However the cause of the elevation does not appear to alter the prognostic value. Also, if a threshold level of B-type natriuretic peptide that is consistent with a diagnosis of cardiac failure is found in a patient due to be undergoing elective surgery, then this should be postponed until the patient's medical treatment has been fully optimised.

The history is suggestive of severe congestive cardiac failure and angina. How would you investigate this further to decide whether it is safe to proceed to anaesthesia for this patient?

Non-invasive tests:

- ECG – looking for any arrhythmia or evidence of ventricular hypertrophy or myocardial ischaemia and infarcts.
- Exercise tests such as the exercise tolerance test – the patient is exercised on a treadmill to a fixed Bruce protocol while ECG readings are taken looking for ischaemic changes. Alternatively, a simple 6-minute walk test where a patient is asked to walk around a circuit with an oxygen saturation probe attached. The distance achieved over 6 minutes is recorded alongside any desaturation that occurred.
- Cardiopulmonary exercise testing (CPEX) – exercise tests are often limited due to disabilities such as arthritis or visual impairment preventing the patient from sustaining exercise. CPEX testing helps overcome this.
- Echocardiography can be used to establish and define the cardiac anatomy and assess ventricular and valvular function; however, this assessment of left ventricular function represents a static measure and gives no indication of the patients functional reserve.
- More invasive tests to establish the extent, sites and severity of coronary artery stenosis include coronary angiography.
- Dobutamine stress echocardiogram, which has the advantage of as well as looking at the function of the heart, establishes how well it performs under stress due to the dobutamine.
- Also dipyridamole–thallium scan tests can be used to identify areas of the myocardium that are under-perfused whilst the heart is under the relative stress of dipyridamole.