Section 1 Medicine

Chapter 1.1

Bone, Joint and Connective Tissue

1.1.1 Rheumatoid Arthritis – Jade A Loughran and Sarah F Bell

You are on the ward reviewing a 55-year-old woman 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 1–2% of the UK population. It is more prevalent in women, affecting women three times more than men. The onset is generally between 30 and 55 years of age. 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 to joint destruction.

What is Still's disease?

Adult-onset Still's disease is similar to the childhood condition of systemic-onset juvenile idiopathic arthritis. It usually presents in young adults with joint pain and inflammation, fever and skin rashes, and can develop into chronic arthritis.

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 multisystem condition that can have a number of implications for the anaesthetist. I would 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 technique chosen.

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** which are worse in the morning and improve with activity. The symptoms may occur as flareups 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 movements. I would also want to know about the drug treatments the patient has tried and is currently taking.

So what can you tell me about rheumatoid neck disease?

The atlantoaxial 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 atlantoaxial 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. Concurrent osteoporosis can be 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 tempromandibular or cricoarytenoid joints are affected since this might have implications for intubation and airway management. With regard to the temporomandibular joint I would ask about mouth opening. The symptoms of cricoarytenoid 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 regard to the respiratory system I would be looking for any evidence of associated pulmonary fibrosis, vasculitis, pulmonary hypertension, pulmonary nodules or 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 flareup. A leucopenia may also be seen.

And what about the nervous system?

The patient might develop peripheral neuropathy from 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 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 rheumatoid arthritis. This might be identified as acute or chronic renal failure. Many of the medications used to treat rheumatoid arthritis may also affect renal function.

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. It affects 1–3% of patients with rheumatoid arthritis.

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 regard to the skin, rheumatoid nodules are

common. Steroid treatment can cause thin, papery skin to develop, which needs to be handled extremely carefully to avoid trauma.

Let's consider the drugs 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 nonsteroidal anti-inflammatory medications for pain relief. These can cause renal impairment, gastrointestinal ulceration, reduced platelet function and exacerbation of asthma in susceptible individuals.

The disease-modifying antirheumatic drugs such as methotrexate, sulfasalazine and hydroxychloroquine are commonly used in the treatment of rheumatoid arthritis. Methotrexate, in particular, has significant side effects causing fibrotic changes in the lungs and liver. Azathioprine, gold and penicillamine have also been used in the treatment of rheumatoid disease. These drugs can all cause bone marrow suppression, lung toxicity, liver dysfunction, thrombocytopenia, anaemia and renal side effects.

Immune-modulating therapies such as rituximab are increasingly used in these patients. These medications can affect the respiratory, renal, hepatic and cardiac systems and affect the haematological and immune functions.

Steroids are frequently given to patients with rheumatoid arthritis flareups. They have many side effects, including hypertension, diabetes, obesity, adrenal suppression, fragile skin, peptic ulcer disease and electrolyte changes. Patients on high doses or long-term steroids may need additional steroid cover perioperatively.

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 your 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 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 she was taking and ask whether she had any allergies. Finally, I would discuss starvation history and ask about 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 ECG as 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 regard to the airway, indirect laryngoscopy might be required if I suspected that the cryco-arytenoid 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 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 with a local anaesthetic and intrathecal opioid. In addition I would consider performing nerve blocks to provide additional postoperative analgesia. I would offer the patient intraoperative sedation. I would use a multimodal approach to postoperative analgesia, including regular paracetamol, non-steroidals, opioids and regular long-acting oral morphine and a short-acting preparation for breakthrough pain.

What are the potential problems with these techniques?

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, postdural puncture headache, postoperative nausea and vomiting, respiratory depression and urinary retention. It is important that the nurses looking after the patient postoperatively are aware of these potential complications.

With regard 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, block failure, intravascular 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 fiberoptic intubation, gas induction, IV induction, rapid sequence induction and insertion of either an endotracheal tube or an LMA.

What are the options for analgesia for total knee replacement?

A multimodal approach would be appropriate for patients undergoing total knee replacement. Pre-emptive analgesia can be considered on the day of surgery, which

may include an anti-inflammatory, modified-release opioid and/or neuropathic agents such as gabapentin or pregabalin. Pre-emptive anti-inflammatories have been shown to reduce postoperative opioid requirements. Particular caution should be taken in the elderly when using opioids or antineuropathic agents.

The postoperative analgesia strategy would depend partly on the anaesthetic technique. If a spinal is being performed, intrathecal opioid can be used. Regional nerve blocks could be used with either a general anaesthetic or neuraxial technique, and wound catheters can be used. These techniques allow reduction in opioid requirements. In particular, an adductor canal block allows early postoperative mobilisation when compared with femoral nerve blocks, which can cause quadriceps weakness, or sciatic nerve block, which can cause foot drop, both of which can impact postoperative mobilisation.

Postoperatively I would prescribe regular paracetamol and a nonsteroidal anti-inflammatory unless contraindicated. I would add a long-acting opioid if the patient did not have a PCA, with a short-acting opioid for breakthrough pain. Other adjuncts such as pregabalin/gabapentin would depend on the individual patient.

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 axis, occurring with doses of 5 mg or more of prednisolone when taken for at least 1 month. This axis is activated by major stress. It is therefore important to consider steroid replacement therapy for patients presenting for surgery to avoid perioperative haemodynamic instability due to adrenal crisis.

The AoA, Royal College of Physicians and the Society for Endocrinology released joint guidelines in 2020 on perioperative steroid cover. They suggest that for patients with adrenal insufficiency of any cause, including long-term steroid therapy, 100 mg hydrocortisone should be given at induction of anaesthesia, followed by a continuous infusion of hydrocortisone 200 mg/24 hours until the patient is able to take oral medications. At this point the steroid can be switched to double their usual oral dose, continued in most cases for 48 hours before dropping back to the usual dose. Major complications or critical illness may confer the need for longer periods of additional cover.

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

10 mg prednisolone is equal to 1.5 mg dexamethasone, 8 mg methylprednisolone and 40 mg hydrocortisone.

Further Reading

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Section 1 Medicine

Chapter 1.2

Cardiovascular

1.2.1 Preoperative Assessment and Management of Patients with Cardiac Disease – Timothy JB Wood and Andrew Weir

You are in the pre-assessment clinic seeing a 66-year-old man 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 cardiorespiratory systems are inextricably linked and would form the focus of my attention in this patient.

Specifically, I would enquire about the following:

- Whether he suffers from hypertension, was on treatment for it and how well controlled it is.
- Has he ever had a myocardial infarction, and if so, what treatment did he have?
- 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 have not been explained?
- Has 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 has to stop, 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 man 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 represent poor exercise tolerance and this group of patients has a higher rate of perioperative and postoperative cardiovascular and neurological complications. However, often this system is limited due to a 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 loss of consciousness. Shortness of breath on exertion, orthopnoea, 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

- Moderate stenosis is equal to an area of 0.8–1.2 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 such as diuretics that the patient is taking
- Specific investigations may be required depending on the history, for example these may include liver function tests and B-type natriuretic peptide.

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 could include:

- 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 (CPET) – 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 patient's 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.

Can you tell me about cardiopulmonary exercise testing (CPET)?

Cardiopulmonary exercise testing is a means of objective testing to determine a patient's preoperative fitness. It correlates well with postoperative survival and can be used to identify patients who are at increased risk of adverse postoperative outcome for which surgery may be deemed inappropriate, or the patient can be warned of the high risks. It examines the ability of the cardiovascular system to deliver oxygen to tissues during the stress of exercise. This is done by asking the patient to exercise on an ergometer, usually a bike, but the hands can peddle instead if there are difficulties with the lower limbs. At the same time as they are exercising a number of variables are being measured. These are as follows:

- ECG
- Blood pressure
- Expired air flow
- Oxygen uptake from the air
- CO_2 production by the body

From these variables the volume of oxygen consumed (VO_2) in millilitres per minute and the volume of carbon dioxide produced (VCO_2) in millilitres per minute can be calculated. If the VO_2 and VCO_2 are plotted on the same graph against time there is a point where the rise in VCO_2 becomes disproportionate to the rise in VO_2. This indicates the level of exercise where the body has reached its maximum aerobic capacity. This point is termed the anaerobic threshold. An anaerobic threshold of less than 11 ml/kg/min or a VO_2 peak of less than 15 ml/kg/min has been shown to have a higher risk of cardiorespiratory events or death postoperatively. Interestingly, 4 METs equates to about 14 ml/kg/min of oxygen consumption. The advantages of CPET testing are that it objectively quantifies function, as opposed to a subjective assessment of the patient's ability to exercise and perform daily tasks. It provides a means of assessment for patients that fall in the category of not being able to achieve 4 METs or are unable to exercise due to other limitations. An important role of CPET is in planning a patient's postoperative destination. Older and colleagues in their paper in 1999 identified patients at high risk undergoing major abdominal surgery with CPET testing. The patients with anaerobic