

HEE summer school 2019 – PBL

- 1 Mick is a 27-year-old male. He comes to the emergency department (ED) of the local
- 2 hospital complaining of severe pain in his right knee. He says that it started
- 3 yesterday and has rapidly become more severe. He is also feeling shivery and weak.
- 4 The ED registrar, Dr Olszewska, sees Mick to take a history and perform an
- 5 examination. Dr Olszewska records the following details:

Height:	1.78 m	Weight:	58.5 kg
Ethnicity:	white; has lived in the area all his life		
Social history:	occasional work helping his cousin who is a carpet fitter; has been making reasonable money recently; lives with his partner and their 2-year-old daughter		
Smoker:	10–12 /day (roll-ups)		
Alcohol:	approx. 25 units/week		
Other drug use:	admits to occasional cannabis smoking, as well as use of oral benzodiazepines and tramadol		
Past medical history:	asthma; bowel problems diagnosed as IBS		
Medication:	“blue inhaler” (salbutamol 200 µg) used as needed; has prescription for “brown inhaler” (precise drug not known) but doesn’t use it		
Allergies:	pollen, dust, cats; no known drug or latex allergies		

- 6 Vital signs are: temperature 38.7°C; pulse 74 beats/min; blood pressure
- 7 115/77 mmHg; respiratory rate 18 breaths/min.
- 8 On examination, Mick’s right knee is red, hot and swollen. It is intensely painful when
- 9 touched and has very limited movement.
- 10 Dr Olszewska tells Mick that she needs to arrange an X-ray and take some blood,
- 11 and that he will have to be admitted to the hospital. She explains that they will need
- 12 to take a sample of fluid from his knee joint. Mick doesn’t like the sound of this.

Pause for discussion

- 13 Mick has been transferred to the medical assessment unit (MAU) and given some
- 14 paracetamol while waiting for the results of his tests but doesn’t feel like it has
- 15 helped much. A nurse takes swabs from Mick’s nose, armpit and groin. Mick notices
- 16 that the nurse says something about MRSA. Another registrar, Dr Suresh, comes to
- 17 see him to go through his results. She explains that his X-ray doesn’t show any
- 18 significant joint damage but his blood tests show that he has an inflammatory
- 19 condition and suggest an infection.

20 Dr Suresh performs an arthrocentesis procedure to collect a sample of fluid from
21 Mick's knee, which she sends for analysis and culture. She explains that she is going
22 to begin treatment with intravenous antibiotics because it looks like he has picked up
23 an infection that has been carried in his blood and lodged in his knee, and he will
24 also need to be tested for other possible infections. She says this is quite unusual
25 and dangerous and asks whether he knows how he might have got an infection in
26 his blood. Eventually, after much prompting, Mick admits to having injected himself
27 twice with heroin, most recently two days ago, and further admits that he wasn't
28 careful about making sure the syringe and needle were clean. Dr Suresh tells Mick
29 that he should be tested for a variety of infections that he might have been exposed
30 to, including HIV. She asks what vaccinations he has had and takes more blood
31 samples for tests. Mick has a cannula put into his arm for administration of
32 antibiotics.

Pause for discussion

33 When the initial results of his arthrocentesis are returned, they show the fluid from
34 Mick's knee is cloudy and contains large numbers of leukocytes but no crystals.
35 They are still waiting for a full report from the microbiology lab but there are Gram-
36 positive cocci in the sample, confirming a diagnosis of septic arthritis.

37 Dr Suresh arranges for Mick to be transferred to an orthopaedic ward the next
38 morning for an arthroscopy procedure, where the knee joint will be drained and
39 cleaned. The orthopaedic surgeon, Mr Howe, tells him that he will need to remain in
40 hospital for at least two weeks for antibiotics to clear the infection. Results from his
41 swabs show he doesn't have MRSA, and Mr Howe is hopeful that the microbiology
42 results from the arthrocentesis will confirm that the antibiotic won't need to be
43 changed.

44 The day after the arthroscopy, the full microbiology results are available. These show
45 that Mick's infection is sensitive to the antibiotic he has been prescribed. Mr Howe
46 says that he should be able to go home after two weeks but will have to continue to
47 take oral antibiotics for another four weeks. Mick is still waiting for the results of his
48 other tests and is very worried about HIV. He has been told about the importance of
49 seeking help with his substance abuse and feels apprehensive of all the
50 appointments he will have when he leaves hospital.

Suggested learning objectives

1. Why is Mick at risk of blood-borne infections? What other illnesses apart from joint infection is he at risk of?
2. Does Mick enjoy good health normally? Is he more or less likely than other people to become ill?
3. What were the doctors looking for in Mick's blood and knee (synovial) fluid?
4. What does a knee joint contain? What might be causing it to hurt?
5. Why was Mick's knee red, hot and swollen?
6. Why did Mick have a fever?
7. Why did Dr Suresh suspect Mick had been taking drugs intravenously?
8. Why did Dr Suresh commence antibiotic treatment before she had the microbiology results?
9. How did Dr Howe know what the infection was, and that it was sensitive to the original antibiotics?
10. What support is available for people with substance abuse issues?

Associated learning

Wednesday: anatomy of joints (knee); laboratory identification of microorganisms; mini-lectures (identification of microorganisms; what is health?)

Thursday: emergency medicine simulations; general practice scenarios

Friday: psychiatry scenarios (including substance abuse)

Tutor notes

This is a case of septic arthritis caused by haematogenous spread of infection from an intravenous injection site. This is a rare condition but is a medical emergency when it occurs.

Unfamiliar terms to look up

Obviously, this depends on what the students think they already know. The following are terms they are likely to need to look up (in order of appearance):

latex	in this context, natural rubber used in manufacture of some medical products (surgical gloves used to be made of latex); causes mild allergic reactions in around 4½% of patients and 10% of healthcare workers; a smaller number of people may experience severe allergic reactions – including anaphylaxis – on exposure to even small amounts of latex
MRSA	meticillin-resistant <i>Staphylococcus aureus</i> : this will be explored later
arthrocentesis	piercing a joint to withdraw a sample of fluid (Greek: arthron – joint; kentesis – the act of pricking)

cannula	thin tube inserted into a blood vessel to withdraw blood and/or administer fluids/drugs
leukocytes	white blood cells (Greek: leukos – white; kutos – vessel/jar)
Gram-positive cocci	this will be covered in other sessions; it means round bacteria (singular coccus; plural cocci), as opposed to rod-shaped ones (singular bacillus, plural bacilli), that retain a specific laboratory stain called Gram (not to be confused with gram, the unit of mass)
septic	related to infection
orthopaedic	literally “straight child” (Greek: orthos – correct or straight; paedon – child [as in paediatrician]); branch of surgery dealing with musculoskeletal conditions
microbiology	study of the biology of “microbes” or microorganisms, including any organism too small to be seen with the naked eye; usually used to refer to organisms not made up of multiple cells (bacteria, protozoa, and unicellular fungi and algae) but can also include prions, viruses and microscopic multicellular parasites
arthroscopy	insertion of a tube into a joint space; the tube has fibre-optic cables attached to a light source and a camera, allowing viewing of the inside of the joint (hence –scope); fluid is passed through the tube to wash out the joint, and flexible implements may also be passed through to scrape out damaged tissue and encourage healing

Paragraph 1

Rapidly worsening joint pain suggests something is triggering an acute inflammatory reaction.

“Shivery and weak” suggests fever. Encourage students to think about times when they’ve felt shivery and weak: what was causing it?

Paragraph 2

Height & weight: Mick is slightly underweight (BMI = 18.46).

Other details suggest low socio-economic status, risk-taking behaviours, poor adherence to medical treatments and unresolved medical complaints.

Paragraph 3

Vital signs are normal apart from temperature: suggests fever but no haemodynamic alterations. Have students heard of sepsis? Thankfully, Mick doesn’t appear to be in acute danger of this.

Paragraph 4

Cardinal signs of inflammation: *rubor*, *calor*, *tumor* and *dolor*, with *functio laesa* for good measure.

Paragraph 5

Tests will look for signs of joint damage, inflammation (erythrocyte sedimentation rate [ESR], C-reactive protein [CRP] and full blood count), local signs of infection (synovial fluid leukocytes and culture) and possible other inflammatory triggers (monosodium urate crystals: gout). Blood and synovial fluid will be cultured for microorganism identification and antibiotic sensitivities.

TRIGGERS FOR DISCUSSION AT THE PAUSE

What might make someone's knee very painful?

(trauma to bones, ligaments, cartilage, etc.; wear & tear of joint [osteoarthritis]; specific inflammation of joint [e.g. rheumatoid arthritis, gout]; infection)

Why might Mick be shivery & weak?

Does Mick seem to be particularly healthy?

What do you think about Mick's approach to his health?

What do you think about Mick's vital signs?

What kinds of tests do you think Dr Olszewska has ordered?

Why doesn't Mick like the sound of sampling fluid from his knee joint?

Paragraph 6

Paracetamol given purely to control the pain. Is there anything else that he could have been given?

Swabs are taken from all patients about to be admitted to hospital as special infection-control measures will need to be put in place for a patient carrying MRSA. (*Staphylococcus aureus* is a common cause of wound infections. Hospital in-patients are obviously susceptible to this. MRSA is resistant to most antibiotics, so exposing sick patients with wounds, existing infections or suppressed immune function to it is asking for trouble.) Most patients would only have their noses swabbed but Mick presents a major infection risk anyway and will be swabbed more extensively.

X-ray doesn't indicate significant joint/bone damage, so the immediate goal is just to control the inflammation and get rid of whatever's triggering it.

Blood tests show inflammatory condition...: this will be based on non-specific markers of inflammation (ESR, CRP).

...and suggest an infection: this will be based on white cell counts.

Paragraph 7

Arthrocentesis: sampling of synovial fluid from the joint for analysis and culture. They will be looking to see if there are signs of infection in the fluid, or possible other causes of inflammation (e.g. monosodium urate crystals). The fluid will need to be rapidly inspected for the presence of bacteria (Gram stain) and cultured to identify the species and test for antibiotic sensitivities.

Immediate commencement of i.v. antibiotics: why? Mick's knee is seriously inflamed and the most likely cause is an infection. This could rapidly spread, possibly leading to sepsis and organ damage, so immediate intervention is necessary.

Someone with septic arthritis (most likely diagnosis) has something major wrong with him: either he's been exposed to an infected object coming into direct contact with his bloodstream or his immune function is impaired. Either way, he's at significant risk of other infections.

Intravenous drug use: OMFG! Now things are serious! If he's been injecting with dirty needles he could have been exposed to all sorts of infections. Intravenous drug use is one of the most common ways in which infections get introduced to the circulation and reach sites such as joints or the endocardium.

Intravenous drug users are at risk of multiple infections due to viruses (e.g. hepatitis B/C, HIV), bacteria (septic arthritis, infective endocarditis) or fungi (mucormycosis, phycomycosis). Mick might have got off relatively lightly.

Dr Suresh will now have to go through a standard protocol for determining what infections Mick has been vaccinated against and testing for the presence of a range of viruses and bacteria in his blood.

TRIGGERS FOR DISCUSSION AT THE PAUSE

What is paracetamol? Why was it given to Mick? Would you expect it to help much?

What does "an inflammatory condition" mean?

Why might Dr Suresh think Mick has an infection?

How do you think arthrocentesis would work? What would be done with the samples?

Why would it be unusual for someone who hasn't suffered knee trauma to get an infection in his knee?

What are the risks of intravenous drug use? What other infections is Mick at risk of?

Paragraph 8

Fluid is cloudy (turbid): body fluids should be sterile and clear. Turbidity indicates something is floating in the fluid. May be cells, microbes, insoluble proteins...

Large numbers of leukocytes. Part of the body's response to infection: get as many neutrophils there as quickly as possible to engulf/kill any bacteria and send in lymphocytes to mount specific responses to the microorganism.

No crystals: possible differential diagnosis would be gout, which is caused by deposition of uric acid in joints in the form of monosodium urate, which is poorly soluble and readily crystallizes out of solution.

Gram-positive cocci: initial evidence of presence of particular bacteria. Most common causative agents for septic arthritis are *Staphylococcus aureus* (Gram-positive) and, less often, *Neisseria gonorrhoeae* (Gram-negative). *Streptococcus pyogenes* (also Gram-positive) is some way behind but is responsible for some cases. Doctor now has some idea of what she's aiming at, and will know if her choice of initial antibiotic was correct.

Initial treatment would most likely be with i.v. flucloxacillin, which is effective against β -lactamase-producing bacteria like *S. aureus* (but not MRSA), but not particularly effective against common Gram-negative bacteria.

Paragraph 9

Orthopaedic ward: septic arthritis is a surgical case.

Arthroscopy: the knee joint will be drained and washed with sterile saline solution to remove cells, bacteria and any debris from damaged tissue. Any damaged tissue that might form a harbour for bacteria to grow can be scraped out. The antibiotics should bring the infection under control.

Two weeks: this is a major systemic infection. It is difficult to administer i.v. antibiotics at home, and medical staff will want to keep Mick under observation to make sure the infection is being cleared. In any case, he still needs to be tested for all those other infections.

Doesn't have MRSA: well, that's a relief, at least.

Paragraph 10

Mick's infection is sensitive to [flucloxacillin]. How would they know this? Material from the swabs is cultured on nutrient agar with discs containing various antibiotics placed on it. If the bacteria don't grow around a disc, the bacterium is sensitive to that antibiotic.

Oral antibiotics for four weeks: need to make sure all trace of the infection is cleared but can step down from i.v. to oral once it's safe to do so.

Worried about HIV: what do students know about HIV? It infects certain lymphocytes and provokes the rest of the immune system to destroy them, causing a loss of immune function. Once it's established it needs lengthy treatment with multiple drugs to get rid of enough of the virus to remove the danger of immunosuppression and transmission.

Substance abuse & appointments: Mick clearly has lots of things to follow up, both to make sure he doesn't have further dangerous infections and to alter his risky behaviours.

TRIGGERS FOR DISCUSSION AT THE END

What are leukocytes?

What does "Gram-negative cocci" mean? Is this important?

What does Dr Suresh mean by "crystals"?

What was Dr Suresh basing her choice of antibiotic on?

Why might the bacteria causing Mick's infection not be sensitive to this first antibiotic?

Why two weeks of i.v. then four weeks of oral?

What's going to happen to Mick when he gets out of hospital?