# Pyomyositis in Adults – Microbiology Full Clinical Guideline

Reference number: CG-AB/3670/23

## Introduction

- Microbial invasion of skeletal muscle and host inflammatory responses can cause pain, tenderness, and swelling of the musculature, i.e. pyomyositis.
- One of the outcomes of infection-inflammation can be the formation of an encapsulated lesion containing necrotic immune cells and invading pathogens, i.e. an intra-muscular abscess.

- The commonest cause of pyomyositis is *Staphylococcus aureus*.
- *Streptococcus* group A is another relatively common bacterial cause.
- Less common causes include other *Streptococcus* species, *Enterobacterales* (e.g. *Escherichia coli*), *Pseudomonas* species, and anaerobic bacteria.

- The pathogens of pyomyositis can be inoculated through various mechanisms of transmission:
    - Haematogenous:
        - Another focus of infection culminates in bacteraemia; the microorganism disseminates via the blood and inoculates the skeletal muscle.
    - Traumatic:
        - E.g. puncture wound of intravenous drug usage (IVDU).
    - Contiguous:
        - Another focus of infection (e.g. appendicitis) disseminates locally and invades the musculature.

- Symptoms and signs of pyomyositis include muscle pain, fever, skin erythema, tenderness, swelling, and a fluctuant/firm/woody mass.
- Temperatures > 38 ° C or < 36 ° C, a respiratory rate > 20 breaths/minute, a heart rate > 90 beats/minute, and hypotension can denote progression of localised infectious disease into sepsis and septic shock.

## Differential diagnosis

- The symptoms and signs of pyomyositis can be mimicked by other infectious and non-infectious pathologies.
- Infectious mimickers include osteomyelitis, septic arthritis, cellulitis, and appendicitis.
- Non-infectious mimickers include compartment syndrome, deep vein thrombosis, diabetic muscle infarction, haematoma, muscle contusion, muscle strain, and sarcoma.

## Investigation

### Radiology

- First line: magnetic resonance imaging (MRI).
- Second line: computed tomography (CT) with contrast.

### Microbiology

- With the range of bacterial pathogens, variations in resistance and susceptibility profiles, contraindications, and side-effects, microbiological investigation enables best antibiotic practice:

- Before starting antibiotics: blood cultures × 2, drawn approximately 1-15 minutes apart, from 2 locations/venepunctures.
- If surgery or radiology intervene:
  - Fluid, pus, or tissue for microscopy, culture, and susceptibility (MC&S).

### Blood sciences

- Full blood count (FBC), international normalised ratio (INR), C reactive protein (CRP), erythrocyte sedimentation rate (ESR), creatine kinase (CK), lactate, urea and electrolytes (U&Es), and liver function tests (LFTs).

## Treatment

### Surgical opinion ± intervention

- Pyomyositis can progress from localised infectious disease into sepsis.
- Early discussion with the orthopaedic registrar/consultant on call is recommended.
- Surgical intervention could enable: (i) elimination of the origin(s) of the infectious episode; (ii) reduction of the microbial inoculum; (iii) identification of the causative agent(s); and, (iv) restoration of host physiological function.
- Equally, source control via radiological intervention can be considered.
- If the surgical team consider radiological intervention, consultant to consultant discussion is recommended.

### Radiological opinion ± intervention

- Interventional radiology with:
  - Ultrasound (US)- or CT-guided percutaneous aspiration or drainage can be considered for intra-muscular abscesses, especially if surgical drainage is contraindicated.
- Drainage could enable: (i) reduction of the microbial inoculum; (ii) identification of the causative agent(s); and, (iii) restoration of host physiological function.
- However, pyomyositis-associated intra-muscular abscesses can be complex; varying from single to multifocal, from superficial to deep, and relative proximity to anatomy that could be cross-contaminated.
- Consultant to consultant discussions - regarding the specific patient, contraindications, and complications – are recommended.
- Interventional radiology requires:
  - An electronic request; and
  - Informed consent for the procedure (https://derby.koha-ptfs.co.uk/cgi-bin/koha/opac-detail.pl?biblionumber=774); and
  - An up-to-date platelet count and clotting (https://derby.koha-ptfs.co.uk/cgi-bin/koha/opac-detail.pl?biblionumber=1577)

  to be completed by the referring team.
- Please note, in general, local Trust policy requires omission of antiplatelets (e.g. clopidogrel for 5-7 days) and anticoagulants (e.g. warfarin for 5 days, apixaban or rivaroxaban for 48 hours) before radiological intervention.
- Possible exceptions – wherein the clinical condition dictates drainage or antiplatelet/anticoagulant omission is contraindicated – require surgical consultant to interventional radiologist consultant discussion, regarding potential benefits and risks of intervention.

## Empiric, intravenous antibiotics

- If there is no history of immunocompromise or IVDU:

| | No history of methicillin resistant *Staphylococcus aureus* (MRSA) | History of MRSA |
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| First line | Flucloxacillin 2 g 6 hourly | Vancomycin or teicoplanin, dose as per hospital guidelines, vancomycin target pre dose level 15-20 mg/l, teicoplanin target pre dose level 15-30 mg/l |
| Second line | If non-immediate without systemic involvement penicillin allergy, cefuroxime 1.5 g 8 hourly | Daptomycin 6 mg/kg 24 hourly |
| Third line | If immediate rapidly evolving or non-immediate with systemic involvement penicillin allergy, vancomycin or teicoplanin, dose as per hospital guidelines, vancomycin target pre dose level 15-20 mg/l, teicoplanin target pre dose level 15-30 mg/l | Linezolid 600 mg 12 hourly (or per oral [absorption 100%]) |

- If there is history of immunocompromise or IVDU:

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| First line | Piperacillin tazobactam 4.5 g 6 hourly **and** Vancomycin or teicoplanin, dose as per hospital guidelines, vancomycin target pre dose level 15-20 mg/l, teicoplanin target pre dose level 15-30 mg/l |
| Second line, if non-immediate without systemic involvement penicillin allergy | Ceftazidime 2 g 8 hourly **and** Vancomycin or teicoplanin, dose as per hospital guidelines, vancomycin target pre dose level 15-20 mg/l, teicoplanin target pre dose level 15-30 mg/l |
| Third line, if immediate rapidly evolving or non-immediate with systemic involvement penicillin allergy | Ciprofloxacin 400 mg 8 hourly **and** Vancomycin or teicoplanin, dose as per hospital guidelines, vancomycin target pre dose level 15-20 mg/l, teicoplanin target pre dose level 15-30 mg/l |

## Directed, intravenous antibiotics (with susceptibilities)

- Methicillin susceptible *Staphylococcus aureus* (MSSA), according to susceptibilities:
    - First line:
        - Flucloxacillin 2 g 6 hourly.
    - Second line, if non-immediate without systemic involvement penicillin allergy:
        - Cefuroxime 1.5 g 8 hourly.
    - Third line, if immediate rapidly evolving or non-immediate with systemic involvement penicillin allergy:
        - Vancomycin or teicoplanin, dose as per hospital guidelines, vancomycin target pre dose level 15-20 mg/l, teicoplanin target pre dose level 15-30 mg/l.

- MRSA, according to susceptibilities:
    - First line:
        - Vancomycin or teicoplanin, dose as per hospital guidelines, vancomycin target pre dose level 15-20 mg/l, teicoplanin target pre dose level 15-30 mg/l.
    - Second line:
        - Clindamycin 600 mg 6 hourly.
    - Third line:
        - Linezolid 600 mg 12 hourly (or per oral [absorption 100%]).
- *Streptococcus* species, according to susceptibilities:
    - First line:
        - Benzylpenicillin 1.2 g 6 hourly.
    - Second line, if non-immediate without systemic involvement penicillin allergy:
        - Cephalosporin; narrowest spectrum of cefuroxime 1.5 g 8 hourly or ceftriaxone 2 g 24 hourly.
    - Third line, if immediate rapidly evolving or non-immediate with systemic involvement penicillin allergy:
        - Vancomycin or teicoplanin, dose as per hospital guidelines, vancomycin target pre dose level 15-20 mg/l, teicoplanin target pre dose level 15-30 mg/l.
- *Enterobacterales* (e.g. *Escherichia coli*) according to susceptibilities:
    - First line:
        - Penicillin; narrowest spectrum of amoxicillin or co-amoxiclav or piperacillin tazobactam standard dosage.
    - Second line, if non-immediate without systemic involvement penicillin allergy:
        - Cephalosporin; narrowest spectrum of cefuroxime 1.5 g 8 hourly or ceftriaxone 2 g 24 hourly.
    - Third line, if immediate rapidly evolving or non-immediate with systemic involvement penicillin allergy:
        - Ciprofloxacin 400 mg 12 hourly (consider per oral [absorption 60-80%]).

## Multi-disciplinary meeting, intravenous to per oral step down, and outpatient parenteral antimicrobial therapy

- After ≥ 2-3 days of intravenous antimicrobial chemotherapy, if the patient is afebrile, observations stable, and inflammatory markers downward trending, collaborate with the medical/surgical consultant regarding their preference for:
    - Referral to the University Hospitals of Derby and Burton (UHDB) orthopaedic multi-disciplinary meeting (1200-1300 Fridays); or
    - Per oral step down; or
    - Outpatient parenteral antimicrobial therapy (OPAT).

  NB If for orthopaedic multi-disciplinary meeting discussion, please liaise with the clinical audit team of the orthopaedic department, of the Royal Derby Hospital, regarding the pro forma and the Microsoft Teams meeting hyperlink.
- After ≥ 2-3 days of intravenous antimicrobial chemotherapy, if the patient is febrile, observations unstable, and/or inflammatory markers upward trending, collaborate with the surgeons/radiologists regarding ± further intervention, update the microbiologist, and continue intravenous therapy.

## Directed, per oral antibiotics (with susceptibilities)

- MSSA, according to susceptibilities:

    - First line:
        - Flucloxacillin 1 g 6 hourly.
    - Second line:
        - Doxycycline 100 mg 12 hourly.
    - Third line:
        - Clindamycin 300-450* mg 6 hourly.
- MRSA, according to susceptibilities:
    - First line:
        - Doxycycline 100 mg 12 hourly.
    - Second line:
        - Clindamycin 300-450* mg 6 hourly.
    - Third line:
        - Linezolid 600 mg 12 hourly**.
- *Streptococcus* species, according to susceptibilities:
    - First line:
        - Amoxicillin 500 mg-1* g 8 hourly.
    - Second line:
        - Doxycycline 100 mg 12 hourly.
    - Third line:
        - Clindamycin 300-450* mg 6 hourly.
- *Enterobacterales* (e.g. *Escherichia coli*), according to susceptibilities:
    - First line:
        - Narrowest spectrum of amoxicillin 1 g 8 hourly, or co-amoxiclav 625 mg 8 hourly plus amoxicillin 500 mg 8 hourly.
    - Second line:
        - Co-trimoxazole 960 mg 12 hourly.
    - Third line:
        - Ciprofloxacin 500 mg 12 hourly.
- * Final dosage to be tailored to specific parameters of the patient (e.g. weight) and the pathogen (e.g. minimum inhibitory concentration) in collaboration with the microbiology consultant responsible for sterile site investigation or within the orthopaedic multi-disciplinary meeting.
- ** In general, maximum duration of treatment 28 days.

### Directed, outpatient parenteral antimicrobial therapy

- Collaborate with the OPAT consultant.

### Empiric, per oral or outpatient parenteral antimicrobial therapy

- If symptoms/signs/radiology features of pyomyositis, and the microbiology is negative, collaborate with a microbiologist regarding empiric options.

### Duration of antibiotics

- If for per oral step down or OPAT, monitor bloods (FBC, CRP, U&Es, and LFTs) weekly-fortnightly.
- 3-4 weeks, from date of radiological or surgical intervention.
- Follow up with the medical/surgical team on intravenous or per oral therapy.

## Management

Clinical concerns re pyomyositis (symptoms and signs include muscle pain, fever, skin erythema, tenderness, swelling, and a fluctuant/firm/woody mass)

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Investigation

- Radiology:
  - First line: MRI
  - Second line: CT with contrast
- Microbiology:
  - Before starting antibiotics: blood cultures × 2, drawn approximately 1-15 minutes apart, from 2 locations/venepunctures
- Blood sciences:
  - FBC, INR, CRP, ESR, CK, lactate, U&Es, and LFTs

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Treatment

- Surgical opinion ± intervention:
  - Consult with the orthopaedic registrar/consultant on call if an intra-muscular abscess/collection has been identified
- ± Radiological opinion and intervention:
  - Interventional radiology with US- or CT-guided percutaneous aspiration or drainage can be considered for intra-muscular abscesses, especially if surgical drainage is contraindicated
  - Surgical consultant to radiology consultant discussions - regarding the specific patient, contraindications, and complications – are recommended
- Empiric, intravenous antibiotics (please note, page 3)

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Investigation (if surgery or radiology intervene):

- Microbiology:
  - Fluid, pus, or tissue for MC&S

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Treatment

- Directed, intravenous antibiotics (please note, pages 3-5)
- ± Referral to the UHDB orthopaedic multi-disciplinary meeting (1200-1300 Fridays)

## References

**Baddour, L. M. and Keerasuntornpong, A.** 2023. Primary pyomyositis. UpToDate. Available at: https://www.uptodate.com/contents/primary-pyomyositis.

**Bennett, J. E., Dolin, R., and Blaser, M. J.** 2015. Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases, 8th Edition. Elsevier.

## Document control

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