

## Tetanus in Paediatrics and Adults; Treatment of Infection - Microbiology Full Hospital Guideline

Reference number:CG-CLIN/4516/24

### Introduction

- Bacterial characteristics of *Clostridium tetani* (*C. tetani*) include:
  - Obligate anaerobic metabolism; and
  - A Gram positive cell wall (i.e. an inner membrane and a thick layer of peptidoglycan); and
  - A rod/bacillus shape; and
  - Spore formation.
- *C. tetani* and tetanus spores reside in environmental, animal (e.g. horse), and human niches:
  1. Soil; and
  2. Manure; and
  3. Faeces; and
  4. Gastrointestinal tract.
- Mechanisms of *C. tetani* and tetanus spore transmission include:
  - Puncture injuries. For example:
    - Gardening injury.
    - Mammalian bite (if the mammal is in agricultural settings or has been rooting in soil).
  - Penetrating injuries. For example:
    - Gunshot.
    - Stabbing.
  - Piercing injuries. For example:
    - Compound fracture.
  - Foreign bodies in wounds.
  - Infected/Septic wounds (including burns).
- In specific hosts (e.g. inadequately vaccinated) exposed to *C. tetani*/tetanus spores:
  - Inoculated tetanus spores may sporulate and *C. tetani* may synthesise and secrete tetanus toxin/tetanospasmin.
    - Tetanus toxin inactivates subpopulations of inhibitory interneurons of the brainstem and spinal cord:
      - With disinhibition of motor neurons; and
      - With disinhibition of autonomic neurons.
        - These disinhibitions may culminate in respiratory failure, cardiac arrhythmia, and death.

### *Clostridium tetani* infectious disease

- In generalised tetanus:
  - The disinhibition of motor neurons causes tonic muscle contractions, spastic muscle contractions, and tetanic spasms:
    - With jaw and neck involvement:
      - With manifestations including trismus, risus sardonicus (= an abnormal grinning expression resulting from involuntary prolonged contraction of facial muscles), and dysphagia.
    - With other skeletal muscle involvement:

- With manifestations including opisthotonos (= the position of the body in which the head, neck, and spine are arched backwards. The muscles of the back, by their spasmodic contraction, arch the body in such a way that the person for a time may rest upon the bed only by their heels and head), rigid abdomen, and clenched fists.
  - The disinhibition of autonomic neurons causes autonomic dysfunction:
    - With sweating and tachycardia in the early phase; and
    - With fever, profuse sweating, and blood pressure lability in the later phases.
- In localised tetanus:
  - The tonic muscle contractions, spastic muscle contractions, and tetanic spasms:
    - Localise to the site of inoculation/infection:
      - With manifestations involving specific body regions (e.g. one extremity).

NB Localised tetanus may progress into generalised tetanus.

- In cephalic tetanus:
  - With head or neck injuries:
    - Tetanus localises to the musculature of the cranial nerves:
      - With manifestations including focal/multiple cranial nerve neuropathy/neuropathies.

NB Cephalic tetanus may progress into generalised tetanus.

- In neonatal tetanus:
  - The disinhibition of motor neurons causes tonic muscle contractions, spastic muscle contractions, and tetanic spasms:
    - With jaw, neck, and other skeletal muscle involvement:
      - With manifestations - including trismus, risus sardonicus, refusal to feed, opisthotonos, rigid abdomen, and clenched hands - emerging, in general, 5 to 7 days postpartum (range 3 to 24 days).

NB The [United Kingdom Health Security Agency \(UKHSA\)](#) outlines neonatal tetanus is also described but has been eliminated in the UK for decades.

### Diagnosis and classification

- The [UKHSA](#) outlines:
  - Tetanus is primarily a clinical diagnosis.
  - The key clinical features of generalised tetanus include at least 2 of the following:
    - 1. Trismus (painful muscular contractions primarily of the masseter and neck muscles leading to facial spasms).
    - 2. Painful muscular contractions of trunk muscles.
    - 3. Generalised spasms, frequently position of opisthotonos.
- The [UKHSA](#) also outlines a probable case can be defined as:
  - In the absence of a more likely diagnosis, an acute illness with muscle spasms or hypertonia, and diagnosis of tetanus by a health care provider.
- The [UKHSA](#) tetanus grading is:
  - Grade 1 (mild)
    - Mild to moderate trismus and/or general spasticity, little or no dysphagia, no respiratory embarrassment.
  - Grade 2 (moderate)
    - Moderate trismus and general spasticity, some dysphagia and respiratory embarrassment, and fleeting spasms occur.
  - Grade 3a (severe)

- Severe trismus and general spasticity, severe dysphagia and respiratory difficulties, and severe and prolonged spasms (both spontaneous and on stimulation).
  - Grade 3b (very severe)
    - As for severe tetanus plus autonomic dysfunction, particularly sympathetic overdrive.

## Investigation

### Microbiology

- If a clinical diagnosis of tetanus has been established:
  - $\geq 200$   $\mu\text{L}$  serum (serum separator tube 'gold top') for:
    - Tetanus neurotoxin antibodies.
- If the surgical team intervenes:
  - Pus or tissue for:
    - Microscopy, culture, and susceptibility (MC&S); and
    - *C. tetani* tetanus neurotoxin gene polymerase chain reaction (PCR).

NB The pus/tissue clinical details to include the diagnosis of tetanus.

## Treatment

### Surgical opinion $\pm$ intervention

- With the rationale of reducing the microbial inoculum of *C. tetani*/tetanus spores that are synthesising and secreting tetanus toxin/tetanospasmin:
  - If the symptoms and signs establish the clinical diagnosis or raise the differential diagnosis of tetanus, collaborate with the relevant surgical registrar/consultant on call.
    - Ophthalmology, maxillofacial, and/or otorhinolaryngology opinions can be required for the head and neck;
    - General surgery and/or obstetrics/gynaecology for the female torso;
    - General surgery and/or urology for the male torso;
    - Orthopaedics for the limbs.
- Surgical interventions may include washouts, drainage, debridement of necrotic tissue, and wound management.

### Directed antibiotics

- With the rationale of antibacterials mediating bacteriostasis/bactericide versus the *C. tetani*/tetanus spores that are synthesising and secreting tetanus toxin/tetanospasmin:
  - First line: metronidazole intravenously.
  - Second line: benzylpenicillin intravenously.

### Immunoglobulin

- With the rationale of neutralising the unbound tetanus toxin/tetanospasmin that inactivates subpopulations of inhibitory interneurons of the brainstem and spinal cord:
  - Human immunoglobulin.
    - If  $< 50$  kg, 5,000 IU intravenously.
    - If  $\geq 50$  kg, 10,000 IU intravenously.
- The [UKHSA](#) outlines:

IVIG products tested for anti-tetanus antibodies	Volume required (in mL) for individuals under 50 kg	Volume required (in mL) for individuals over 50 kg
Gammaflex 5%, Intratect 5%, Flebogamma 5%, Vigam 5%, Octagam 5%	400 mL	800 mL

Privigen 10%, Octagam 10%, Intratect 10%, Flebogamma 10%, Panzyga 10%, Gammunex 10%	200 mL	400 mL
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### Control of motor neuron dysfunction

- In collaboration with the intensive care unit consultant:
  - Sedation with a benzodiazepine.
  - ± Neuromuscular blockade.

### Control of autonomic neuron dysfunction

- In collaboration with the intensive care unit consultant:
  - ± Beta blockade.

## Management

Clinical concerns re tetanus (for example, trismus with no/unknown tetanus vaccination [or immunocompromise] with injury/wound exposed to soil)

- For extra information re diagnosis and classification, please note page 2

Escalation of clinical concerns re tetanus

- Firstly, to the responsible emergency department/medical/surgical consultant on clinical duty/on call
  - Secondly, to the microbiology consultant on clinical duty/on call
  - Thirdly, to the [UKHSA](#) (notifiable diseases include tetanus)

Assessment of airway, breathing, circulation, disability, and exposure ([ABCDE](#))

Investigation

- If a clinical diagnosis of tetanus has been established:
  - $\geq 200$   $\mu$ l serum (serum separator tube 'gold top') for tetanus neurotoxin antibodies

In collaboration with the responsible consultant on clinical duty/on call, referral for level 3 (intensive care unit) management

Immediate treatment

- Surgical opinion  $\pm$  intervention: collaborate with the relevant surgical registrar/consultant on call re debridement of necrotic tissue
- Directed antibiotics: metronidazole intravenously or - if metronidazole is contraindicated - benzylpenicillin intravenously
- Immunoglobulin: human immunoglobulin; if  $< 50$  kg, 5,000 IU intravenously; if  $\geq 50$  kg, 10,000 IU intravenously
- Control of motor neuron dysfunction, in collaboration with the intensive care unit consultant:
  - Sedation with a benzodiazepine
  - $\pm$  Neuromuscular blockade
- Control of autonomic neuron dysfunction, in collaboration with the intensive care unit consultant:
  - $\pm$  Beta blockade

Investigation

- If the surgical team intervenes:
  - Pus or tissue - with clinical details to include the diagnosis of tetanus - for MC&S and *C. tetani* tetanus neurotoxin gene PCR

Later treatment

- Tetanus vaccination

## References

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**Thwaites, L.** 2024. Tetanus. UpToDate. Available at: [Tetanus - UpToDate](#).

**UKHSA.** 2022. Tetanus: the green book, chapter 30. Available at: [Tetanus: the green book, chapter 30 - GOV.UK \(www.gov.uk\)](#).

**UKHSA.** 2024. Guidance on the management of suspected tetanus cases and the assessment and management of tetanus-prone wounds. Available at: [Guidance on the management of suspected tetanus cases and the assessment and management of tetanus-prone wounds - GOV.UK \(www.gov.uk\)](#).

## Document control

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<b>Version:</b>	2
<b>Approval date:</b>	AMSG 16.07.2024 Medicine 24.06.2024
<b>Changes from previous version:</b>	Introduction. <i>Clostridium tetani</i> infectious disease. Diagnosis and classification. Investigation. Treatment. Management. References. Document control.
<b>Date uploaded:</b>	28/11/2024
<b>Next review date:</b>	November 2027
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