PVL-positive Staphylococcus Aureus

PVL-positive *Staphylococcus aureus* (PVL-SA) causes recurrent skin and soft tissue infections (SSTIs), but can also cause invasive infections, including necrotising haemorrhagic pneumonia in otherwise healthy young people in the community.\(^1, 2\) PVL genes are consistently associated with SSTIs and are comparatively rare in invasive disease.\(^3\) The toxin was first described by Panton and Valentine in 1932.

Some *S. aureus* strains carry genes for PVL and at least 14 strains of PVL-positive *S. aureus* are known.\(^4\) It is carried by <2% of isolates of *S. aureus*, both meticillin-sensitive *S. aureus* (MSSA) and meticillin-resistant *S. aureus* (MRSA).\(^5\) PVL-positive *S. aureus* strains are usually associated with community-acquired infections and generally affect previously healthy young children and young adults. Most infection has been associated with PVL-positive MSSA so far in the UK. Community-acquired MRSA is more likely to produce PVL than hospital-acquired MRSA. Carriage of the PVL gene alone may not be the main virulence factor. Factors that up-regulate toxin synthesis in vivo could also contribute to more severe disease and worse outcomes.\(^6, 7\)

There is a separate article on *Meticillin-resistant Staphylococcus aureus* (MRSA).

**Epidemiology**

- Data from the UK in 2010 found that 20% of *S. aureus* isolates from skin or soft tissue infections contained PVL-positive *S. aureus*. Although the sample may have been biased towards the more severe skin or soft tissue infections, the prevalence is considered to be higher than the 2% recorded in 2005.\(^8\)
- Outbreaks have occurred in hospital and community settings.
- The majority have been associated with mild skin/tissue infections.

**Risk factors**\(^1\)

- Contaminated items shared - eg, towels, razors.
- Close contact.
- Crowding.
- Cleanliness: poor hygiene.
- Cuts and other compromised skin integrity.
- Risk groups are often young and healthy, and include closed communities with close contact, close contact sports (eg, wrestling, rugby, judo) military training camps, gyms and prisons.

**Presentation**\(^1\)

There is an asymptomatic carrier status.

Recurrent skin infections include boils (furunculosis), carbuncles, folliculitis and cellulitis. Cutaneous lesions can be more than 5 cm in size, and may be associated with necrosis. Pain and erythema may be out of proportion to the severity of signs.

Invasive infections include:

- Necrotising pneumonia, often after a flu-like illness.
- Necrotising fascitis.
- Osteomyelitis, septic arthritis and pyomyositis.
- Purpura fulminans.

**Skin infection**
Consider screening in anyone if there are recurrent abscesses/furunculosis. Management includes drainage of abscesses and sensitivity testing to find appropriate antibiotics. Swabs should be taken as indicated and, if there is specific reason to suspect PVL-positive *S. aureus*, such as recent contact, it should be stated on the request form. If either MSSA or MRSA is isolated (the latter usually ciprofloxacin-susceptible), refer to the PHE Microbiology Services Bacteriology Reference Department at Colindale for PVL-testing. For urgent requests, contact the Staphylococcal Reference Unit (Tel: 020 8327 7227). A polymerase chain reaction (PCR) test for PVL virulence genes and simultaneous discrimination of MRSA from MSSA has recently been developed.\(^9\) The unit at Colindale can provide a result within the working day.

Mild infections may resolve without treatment. Moderate infections should be treated with flucloxacillin, erythromycin or clindamycin. If community-acquired MRSA-PVL infection occurs and hospitalisation is not thought appropriate, consider a 5-7-day course of one of the following, depending on microbiological susceptibility:

- Rifampicin 300 mg bd PLUS doxycycline (100 mg bd - not for children <12 years).
- Rifampicin 300 mg bd PLUS fusidic acid 500 mg tds.
- Rifampicin 300 mg bd PLUS trimethoprim 200 mg bd.
- Clindamycin 450 mg qds.

Infection control measures include screening of patients for *S. aureus* carriage (swab nose, throat, perineum, axilla, skin lesions). Decolonisation may be needed as with MRSA.

**Necrotising pneumonia**\(^{10}\)

**General points**

- Can arise from blood-borne spread of organisms from infected tissue but can also follow viral respiratory infections. A preceding flu-like illness is common.\(^{11}\)
- Necrotising vasculitis with massive areas of pulmonary infarction and haemorrhage can occur.\(^{11}\)
- Infection tends to be rapidly progressive in young, immunocompetent individuals.
- There is a high fatality rate for patients with invasive infection.
- Some cases have also been identified in people with pre-existing lung disease - eg, cystic fibrosis.\(^{12}\)

**Investigations**\(^1\)

- Multilobar infiltrates on **CXR**, usually accompanied by effusions and later cavitation.
- Marked leukopenia (PVL toxin destroys white blood cells).
- Very high **CRP** level (>250-300 mg/L) - reflecting gross tissue destruction, thrombosis and sepsis.\(^{11}\)
- Staphylococcal-like Gram-positive cocci on Gram film.
- Raised creatine kinase may suggest myositis.
- Swabs:
  - Specimens (swabs) should be taken for recurrent boils/abscesses, necrotising SSTIs and when one or more cases occur in a home or closed community.
  - Swabs (use swab moistened with water or saline) should be taken from skin lesions and anterior nares and placed in transport medium.

- For community-acquired necrotising/haemorrhagic pneumonia, sputum and swabs and also immediate hospital referral are required.

**Management**\(^1\)

- Seek specialist advice if the patient is immunocompromised or deteriorating clinically.
- Minor furunculosis, folliculitis and small abscesses without cellulitis: no antibiotics required but may need incision and drainage.\(^{13}\)
- Other non-suppurative minor SSTIs: oral flucloxacillin is first-line treatment. Second-line treatment is topical fusidic acid or mupirocin.
- Because resistance is increasing, topical antibiotics should be reserved for very localised lesions. Mupirocin should only be used for MRSA.
- Moderate SSTIs - eg, cellulitis or abscesses >5 cm with meticillin-sensitive PVL: flucloxacillin or clindamycin.
If PVL is likely to be MRSA, treat empirically with two agents and then be guided by antibiotic susceptibility results, and by advice of microbiologist/hospital: rifampicin plus doxycycline (not children), sodium fusidate or trimethoprim; alternatively clindamycin alone. Third-line treatment: linezolid.

Severe SSTIs with systemic symptoms or pneumonia: refer immediately.

**Suppression of PVL in patients and their close contacts**

When considering decolonisation of patients and close contacts, discuss risk factors, risk groups, employment settings and compliance with Health Protection Unit/Microbiology.

Offer decolonisation to all primary cases. Suppression of PVL is ineffective if skin lesions are still leaking. Start suppression after the primary infection has resolved.

Topical treatment aims to reduce colonisation and may prevent further infections and interrupt transmission.

**Body**

- Use chlorhexidine 4% body wash or shampoo or triclosan 1-2%. Use daily as liquid soap in the bath, shower or bowl for five days. Use as a shampoo on day 1, day 3 and day 5.
- Pay particular attention to armpits, groins, under breasts, hands and buttocks.
- It should remain in contact with the skin for about a minute.
- Rinse off before drying thoroughly, especially for skin conditions.
- Dermol® should be considered for patients with skin conditions or delicate skin.
- Dermatological opinion may be necessary in patients with skin conditions - eg, eczema.

**Nose**

- Use a matchstick head-sized amount (less for small child) of mupirocin.
- Apply, using a cotton bud, three times a day for five days to the inner surface of each nostril.
- If applied correctly, the patient can taste mupirocin at the back of the throat.

**Follow-up**

- Advise the patient to return if infection persists or recurs.
- Patients with recurrent infections or persistent colonisation should maintain sensible precautions to prevent transmission (see below).
- Only undertake repeated screening/decolonisation if the patient is immunosuppressed, poses a special risk to others (eg, healthcare worker, carer, food handler), or if spread of infection is ongoing in close contacts.

**Prognosis**

- Necrotising pneumonia has a high mortality rate if not diagnosed early and treated energetically. Mortality can be as high as 75%. [14]
- Otherwise, prognosis with this infection is generally good and most of the PVL-SA strains identified in the UK are sensitive to many antibiotics.

**Prevention** [1]

- Cover infected skin with dressings and change regularly.
- Do not touch or squeeze skin lesions.
- Regularly wash hands.
- Avoid bar soap; use pump-action liquid soap.
- Clean the sink and bath after use, using a disposable cloth and detergent; then rinse clean.
- Cough or sneeze into a tissue and then wash hands after immediate disposal.
- Use individual personal towels and face cloths or use paper towels.
- Regularly vacuum and damp dust, especially bedrooms.
- If colonisation persists, consider further treatment and hygiene measures - eg, change sheets daily.
Further reading & references

1. Diagnosis and management of PVL staphylococcus aureus infections, a quick reference guide for primary care; GOV.UK (2014)

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