Chapter 17

SKIN AND SOFT TISSUE INFECTIONS

Skin and soft tissue infections range from mild to severe infections. Systemic involvement may occur and is dependent on the virulence of the organism, host factors (immunity and site of injury), and the severity of the injury.

LABORATORY DIAGNOSIS

MICROBIOLOGICAL CULTURE AND SENSITIVITY	OTHER LABORATORY TESTS
Pus and fluid needle aspirate	Full blood count with differential count
Punch biopsy of tissue	C-reactive protein and procalcitonin
Blood cultures	Histology of a tissue biopsy
	Radiology to exclude bone and deeper structure involvement

TREATMENT

- One or more of general wound care, topical therapy and antibiotics may be required to treat skin and soft tissue infections.
- Empiric antibiotic therapy is selected according to the likely organisms, the site of infection and local antibiotic resistance patterns.
- Targeted therapy should be selected according to the isolated organism(s) and its susceptibility.

SKIN ABSCESSES, FURUNCLES AND CARBUNCLES

Skin abscesses	Pus collection within the dermis and deeper skin tissues
Furuncles (boils)	Infection of the hair follicle in which purulent material extends through the dermis into the subcutaneous tissue
Carbuncles	Coalescence of several inflamed follicles into a single inflammatory mass with purulent drainage from multiple follicles

RISK FACTORS

- Diabetes mellitus
- Immunologic abnormalities
- Primary dermatologic conditions
- IV drug abusers and injections
- Skin and nasal colonisation with *Staphylococcus aureus*

PATHOGENS

- *S. aureus* – both MSSA and MRSA
- Gram-negative bacilli (GNB) and anaerobes (abscesses involving perioral, perirectal, vulvovaginal areas)

TREATMENT

- Incision and drainage is the mainstay of therapy.
- The role of antibiotics is still uncertain but studies have shown that incision and drainage with ancillary antibiotics improved outcome. Antibiotics may also decrease the risk of recurrence.

CRITERIA FOR ANCILLARY ANTIBIOTICS

- Abscess > 5 cm
- Multiple lesions
- Extensive surrounding cellulitis
- Co-morbidities and immunosuppression
- Systemic infection
- Lack of response to incision and drainage

ANTIBIOTIC SELECTION

- Empiric treatment depends on the site of infection and likely organisms – *S. aureus* vs. anaerobes, GNB & local antibiotic susceptibility pattern.
- Antibiotics with MRSA activity should be used if the prevalence is high, there are MRSA risk factors or MRSA colonisation is detected.
- Use oral therapy for localised disease.
- Use IV therapy for extensive infection and systemic toxicity.

TREATMENT: SKIN ABSCESSES, FURUNCLES AND CARBUNCLES

MSSA COVER (EMPIRIC TREATMENT OPTIONS)

Cloxacillin 500 mg PO 6 hourly (children 25–50 mg/kg/day in 4 divided doses)

Cloxacillin 2 g IV 4 hourly (children 25–50 mg/kg/day in 4 divided doses)

OR

Clindamycin 450 mg PO 8 hourly (children 25–30 mg/kg/day in 3 divided doses)

Clindamycin 600 mg IV 8 hourly (children 20–40 mg/kg/day in 3 divided doses)

Use clindamycin if penicillin allergic

Treat for 5–10 days

MRSA COVER (EMPIRIC TREATMENT OPTIONS)

Clindamycin 450 mg PO 8 hourly (children 25–30 mg/kg/day in 3 divided doses)

Clindamycin 600 mg IV 8 hourly (children 20–40 mg/kg/day in 3 divided doses)

OR

Linezolid 600 mg PO or IV 12 hourly (children < 12 years 10 mg/kg/dose PO or IV given 12 hourly)

Treat for 5–10 days

GRAM-NEGATIVE AND ANAEROBE COVER (EMPIRIC OPTION)

Amoxicillin-clavulanate 1 g PO 12 hourly (children 40 mg/kg/day PO in 3 divided doses)

Amoxicillin-clavulanate 1.2 g IV 8 hourly (children 30 mg/kg/dose IV given 8 hourly)

Treat for 5–10 days

CELLULITIS AND ERYSIPELAS

ERYSIPELAS	CELLULITIS
• Involves the upper dermis and superficial lymphatics • Has more distinctive anatomic features • Typically raised lesions above the level of surrounding skin • Clear demarcation between involved and uninvolved tissue • Has an acute onset	• Involves deeper dermis and subcutaneous tissue. • Has a more indolent course • Presents with (typically staphylococcal infection) or without (typically streptococcal infection) purulent drainage or exudates

RISK FACTORS

- Trauma
- Inflammation (eczema and radiation)
- Pre-existing skin infection
- Lymphedema (venous insufficiency)
- Lymphatic obstruction
- Diabetes mellitus

PATHOGENS

- β-haemolytic streptococci (A, B, C, G & F)
- *Staphyloccus aureus:* MSSA or MRSA
- Gram-negative bacilli (minority of cases)
- Special circumstances
  - Orbital cellulitis*: S. pneumoniae*
  - Buccal cellulitis: *H. influenzae*

TREATMENT: CELLULITIS AND ERYSIPELAS

Use oral antibiotics for mild/localised infection and IV for extensive/severe infection or for cellulitis with systemic signs of infection. Total duration of antibiotic therapy is between 5 and 10 days.

EMPIRIC TREATMENT: ERYSIPELAS

Penicillin VK 500 mg PO 6 hourly (children 25–50 mg/kg/day PO in 3 or 4 divided doses)

OR

Amoxicillin 500 mg PO 8 hourly (25–50 mg/kg/day PO in 3 divided doses)

OR

Ceftriaxone 1 g IV once daily (children 50–75 mg/kg/day IV in 1 or 2 divided doses)

EMPIRIC TREATMENT: CELLULITIS

Cloxacillin 500 mg PO 6 hourly (children 25–50 mg/kg/day in 4 divided doses)

Cloxacillin 2 g IV 4 hourly (children 25–50 mg/kg/day in 4 divided doses)

OR

Amoxicillin-clavulanate 1 g PO 12 hourly (children 40 mg/kg/day PO in 3 divided doses)

Amoxicillin-clavulanate 1.2 g IV 8 hourly (children 30 mg/kg/dose IV given 8 hourly)

ALTERNATIVE FOR PENICILLIN ALLERGIC PATIENTS OR WITH SUSPECTED MRSA INFECTION

Clindamycin 450 mg PO 8 hourly (children 25–30 mg/kg/day in 3 divided doses)

Clindamycin 600 mg IV 8 hourly (children 20–40 mg/kg/day in 3 divided doses)

DIABETIC PATIENTS

Diabetic patents are at risk of severe infections. Surgical debridement may be indicated to exclude necrotising fasciitis and X-rays to demonstrate gas. For severe infections use an antibiotic that includes anaerobic and Gram-negative cover. Add MRSA cover if at risk. Options for diabetics with severe infection include:
Meropenem 1 g IV 8 hourly
OR
Imipenem 500 mg IV 6 hourly

For MRSA cover add linezolid 600 mg IV/PO 12 hourly or daptomycin 4 mg/kg IV once daily

IN ADDITION TO ANTIMICROBIAL THERAPY, THE FOLLOWING ARE IMPORTANT ASPECTS IN THE MANAGEMENT OF PATIENTS WITH CELLULITIS:

- Elevate the affected area and treat any underlying predisposing skin conditions.
- With lower limb cellulitis, examine the interdigital toe spaces and treat any fissuring or maceration.
- Anti-inflammatory agents such as prednisone 40 mg daily may be used in non-diabetics to aid clinical resolution. Ensure that deeper infections are not present before starting steroids.

SOFT TISSUE INFECTIONS DUE TO HUMAN AND ANIMAL BITES

Human bites can be incidental or purposeful injuries.

- Incidental injuries: self-inflicted wounds, e.g. paronychia due to nail biting or thumb sucking.
- Purposeful injuries to one individual by another: occlusion bites or clenched fist injuries.
  - Clenched fist injuries are usually serious human bite wounds. They typically present with lacerations over the third and fourth metacarpophalangeal or proximal interphalangeal joints. Relaxation of the fist may carry organisms into the deep compartments and deep tendon spaces of the hand.

PATHOGENS

Include the oral flora and skin flora:

- Oral flora (human): *Eikenella corrodens, H. influenzae, Fusobacterium* spp.
- Oral flora (animal): *Pasteurella* species, *Capnocytophaga canimorsus.*
- Anaerobes: Peptostreptococci, *Prevotella* spp., *Porphyromonas* spp.
- Skin flora: *S. aureus,* streptococci.

TREATMENT

Antibiotics must be given to prevent or treat bacterial infections for:

- Occlusion bite wounds and bite wounds involving the hand
- Wounds in close proximity to a bone or joint (especially prosthetic joints)
- Deep puncture wounds
- Moderate to severe wounds with associated crush injuries
- Bite wounds in areas of underlying venous or lymphatic compromise
- Bite wounds requiring surgical repair
- Bite wounds in immunocompromised patients
- Bite wounds in asplenic patients and those with advanced liver disease

TREATMENT: HUMAN AND ANIMAL BITES

Purulent bite wounds are likely to be polymicrobial (mixed aerobes and anaerobes) whereas non-purulent wounds are often a result of streptococcal or staphylococcal infections.

PRE-EMPTIVE THERAPY AND EARLY WOUNDS

Amoxicillin-clavulanate 875/125 mg PO 12 hourly

OR

Moxifloxacin 400 mg PO once daily

OR

Ciprofloxacin 500 mg PO 12 hourly **AND** metronidazole 400 mg PO 8 hourly

Treat for 5 days

INFECTED WOUNDS REQUIRING INTRAVENOUS TREATMENT

Piperacillin-tazobactam 4.5 g IV 8 hourly

OR

Ceftriaxone 1 g IV once daily **AND** metronidazole 500 mg IV 8 hourly

OR

Moxifloxacin 400 mg IV once daily

Duration of therapy is generally 5–10 days

Duration of therapy for complicated cases:

- Bacteraemia: 14 days
- Tenosynovitis: 4 weeks
- Osteomyelitis: 6 weeks

PROPHYLACTIC VACCINATION

Tetanus immunoglobulin and tetanus toxoid should be administered to patients who have had two or fewer primary immunisations.

Tetanus toxoid alone can be given to those who have completed a primary immunisation series but who have not received a booster for more than five years.

Rabies prophylaxis with both vaccine and rabies immunoglobulin must be given with most animal bites. Refer to the chapter ‘Pre-exposure and post-exposure prophylaxis’ for details.

SOFT TISSUE INFECTION FOLLOWING WATER EXPOSURE

- Soft tissue infection can occur after both fresh water and salt water exposure and associated trauma.
- The most commonly implicated bacteria are:
  - *Erysopelothrix rhusiopathiae*
  - *Vibrio vulnificus*
  - *Aeromonas* species
  - *Mycobacterium marinum*

ERYSIPELOTHRIX RHUSIOPATHIAE

- Gram-positive bacillus that occurs widespread in nature, domestic animals and aquatic animals.
- Human infections occur following occupational exposure, typically fishermen and veterinarians.
- There are three major presentations:
  - Localised cutaneous (erysipeloid) infection
  - Diffuse cutaneous infection
  - Systemic infection (bacteraemia with or without endocarditis)

TREATMENT: ERYSIPELOTHRIX RHUSIOPATHIAE

LOCALISED INFECTION

Penicillin VK 500 mg PO 6 hourly

OR

Ciprofloxacin 250 mg PO 12 hourly (or other fluoroquinolone)

Treat for 7 days

DIFFUSE CUTANEOUS AND SYSTEMIC INFECTION

Penicillin G 2–4 MU IV 4 hourly

OR

Ceftriaxone 2 g IV once daily

OR

Imipenem 500 mg IV 6 hourly

Treat for 4 weeks

NOTE: *Erysipelothrix rhusiopathiae* is resistant to vancomycin

VIBRIO VULNIFICUS

- A free-living bacterium inhabiting estuarine or marine environments.
- Causes wound infections, cellulitis, severe myositis and fasciitis reminiscent of gas gangrene.
- Wound infections occur following exposure of wounds to salt or brackish water.
- It may also cause primary septicaemia and septic shock following ingestion of raw or undercooked shellfish, particularly raw oysters.
- Complicated infections tend to occur in those with underlying chronic liver disease and men are at greater risk than women.

TREATMENT: VIBRIO VULNIFICUS

Combination antibiotic therapy and aggressive surgical debridement should be used.

RECOMMENDED ANTIBIOTIC REGIMEN

Doxycycline 100 mg PO 12 hourly

AND

Ceftriaxone 1 g IV daily or cefotaxime 2 g IV 8 hourly

ALTERNATIVE ANTIBIOTIC REGIMEN

Levofloxacin 500 mg PO or IV once daily

Duration of therapy depends on the severity of the infection and clinical response. Patients with mild to moderate infections generally respond to five to seven days of antibiotics.

AEROMONAS SPECIES

- Gram-negative bacilli that are widely distributed in freshwater estuarine and marine environments.
- Cause mild to severe wound infections, cellulitis, myonecrosis and lesions mimicking ecthyma gangrenosum.
- In addition to wound infections, they may cause diarrhoea and a variety of extra-intestinal infections.

EMPIRIC TREATMENT: AEROMONAS SPECIES

Treatment should be based on laboratory antimicrobial susceptibility of the organism.

A fluoroquinolone, trimethroprim-sulfamethoxazole or a third generation cephalosporin is recommended.

NECROTISING SOFT TISSUE INFECTIONS

- Clinically characterised by fulminant tissue destruction, systemic signs of toxicity and a high mortality.
- Necrotising soft tissue infections include:
  - Necrotising fasciitis: type I (polymicrobial) and type II (group A streptococcal infection)
  - Necrotising form of cellulitis: anaerobic (clostridial and non-clostridial cellulitis) and Meleney's synergistic gangrene
  - Necrotising myositis

NECROTISING FASCIITIS

Necrotising fasciitis is a severe, acute infection involving the subcutaneous soft tissues and fascial layers, typically precipitated by surgery, trauma, peri-rectal abscesses or bedsores.

IT IS COMPRISED OF TWO DISTINCT BACTERIOLOGIC ENTITIES

TYPE I	TYPE II
Mixed infection of aerobic and anaerobic bacteria: Aerobes: streptococci (other than group A) and Enterobacteriaceae, e.g. *E. coli*, *Enterobacter* spp., *Klebsiella* spp. Anaerobes: *Bacteroides* spp., Clostridia, peptostreptococci **Risk factors:** diabetes, peripheral vascular disease, recent surgery	Caused by group A streotococci either alone or in combination with other species, commonly *S. aureus* **Risk factors:** skin injury, blunt trauma, recent surgery, childbirth Can occur in healthy individuals with no past medical history and in any age group

NECROTISING CELLULITIS

Comprised of anaerobic infection and Meleney's synergistic gangrene.

ANAEROBIC CELLULITIS

CLOSTRIDIAL CELLULITIS	NON-CLOSTRIDIAL CELLULITIS
Caused by *C. perfringens, C. sordelli*, *C. septicum*. Characterised by thin, dark, foul smelling wound drainage and tissue gas formation Pain, swelling and systemic toxicity are not prominent features Crepitus observed but there is sparing of fascia and deep muscles	Caused by various non-spore forming anaerobes either alone or as mixed infections with Enterobacteriaceae, streptococci and *S. aureus*. *Bacteroides* spp. and peptostreptococci are usually the implicated anaerobes Clinical features are similar to those of clostridial cellulitis

MELENEY'S SYNERGISTIC GANGRENE

- A rare infection that occurs in postoperative patients.
- Caused by synergistic interactions between *S. aureus* and microaerophilic streptococci.
- Characterised by slow expanding indolent ulceration, confined to the superficial fascia.

TREATMENT: NECROTISING SOFT TISSUE INFECTIONS

Early and aggressive surgical exploration and debridement of necrotic tissue is essential

Haemodynamic support

Broad spectrum empiric antibiotics based on the Gram-stain and culture to determine the likely aetiology (polymicrobial, streptococcal, clostridia, or *S. aureus*)

EMPIRIC ANTIBIOTICS

POLYMICROBIAL INFECTIONS

A carbapenem: ertapenem 1 g IV daily OR meropenem 1g IV 8 hourly OR imipenem 500 mg IV 6 hourly
OR
Piperacillin-tazobactam 4.5 g IV 8 hourly
AND
Clindamycin 600 mg IV 8 hourly

β-HAEMOLYTIC STREPTOCOCCI AND CLOSTRIDIAL INFECTIONS

Penicillin 4 MU IV 4 hourly **AND** clindamycin 600 mg IV 8 hourly

- Vancomycin, linezolid or daptomycin should be added if MRSA is suspected or isolated
- Clindamycin should be added for its antitoxin effects against toxin elaborating strains of streptococci and staphylococci

FOR PENICILLIN ALLERGIC PATIENTS USE

Ciprofloxacin 400 mg IV 8 hourly **AND** clindamycin 600 mg IV 8 hourly

TREATMENT DURATION

Antibiotics should be continued until no further debridements are needed and the patient's hemodynamic status has normalised. Duration must be tailored to individual patient circumstances.

SURGICAL SITE INFECTIONS

- The Centres for Disease Control criteria define surgical site infection (SSI) as infection related to an operative procedure that occurs at or near the surgical incision within 30 days of the procedure or within 90 days if prosthetic material is implanted at surgery.
- There are many risk factors for SSIs including the type of wound (clean, clean-contaminated, contaminated and dirty wounds) as well as patient and surgery related risk factors.
- SSIs are localised to the incision site but can also extend into deeper adjacent structures. The risk of SSIs can be reduced by appropriate wound care and antibiotic prophylaxis (refer to the chapter 'Antibiotic prophylaxis for surgical procedures').
- Criteria for defining a SSI include one or more of the following:
  - A purulent exudates from the surgical incision site
  - A positive bacterial culture from a surgical site that was closed primarily
  - A surgical site that has been opened due to clinical signs of infection
- SSIs are classified as incisional or organ/space. Incisional SSIs are further divided into superficial (involving only the skin or subcutaneous tissue) or deep (involving deep soft tissues of an incision). An organ/space SSI may involve any part of the anatomy (other than the incision) that was opened or manipulated during the operative procedure.

PATHOGENS

- Skin flora: *S. aureus*, coagulase negative staphylococci, streptococci.
- Endogenous flora of the viscus involved are implicated, in addition to skin flora in clean-contaminated, contaminated and dirty wound infections such as Gram-negative bacilli and enterococci.
- Exogenous flora from the operating environment and personnel have also been implicated.

TREATMENT

The most important aspect of treatment of incisional SSIs is to open the incision, evacuate infected material and dress the wound until healing has occurred. Antibiotic therapy is not indicated where there is < 5 cm of erythema and minimal systemic signs of infection. Patients who are pyrexial (> 38.5 °C), have a tachycardia > 110 beats/minute or with erythema > 5 cm beyond the incision margin may require a short course of antibiotics. Directed therapy should be based on results of the organism(s) isolated and their antibiotic susceptibility.

EMPIRIC ANTIBIOTIC THERAPY: INCISIONAL SURGICAL SITE INFECTION

Agents active against Gram-negative bacilli and anaerobes are recommended for infections following operations on the axilla, GIT, perineum and female genital tract. For clean procedures that did not enter the GI or genital tracts, antibiotics active against *S. aureus* and streptococci should be used. The choice of empiric antibiotic should be supported by a Gram stain of the wound contents. Treatment is typically for a short period (2–3 days).

A carbapenem: ertapenem 1 g IV daily or meropenem 1g IV 8 hourly or imipenem 500 mg IV 6 hourly

OR

Piperacillin-tazobactam 4.5 g IV 8 hourly

OR

Ceftriaxone 1 g IV daily **AND** metronidazole 500 mg IV 8 hourly

OR

Amoxicillin-clavulanate 1.2 g IV 8 hourly

For MRSA cover add linezolid 600 mg IV/PO 12 hourly OR daptomycin 4 mg/kg IV once daily