



432 Surgery Team



5 Surgical infections and antibiotic



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COLOR GUIDE: • Females' Notes • Males' Notes • Important • Additional

Objectives

Not given,,!

Infection:

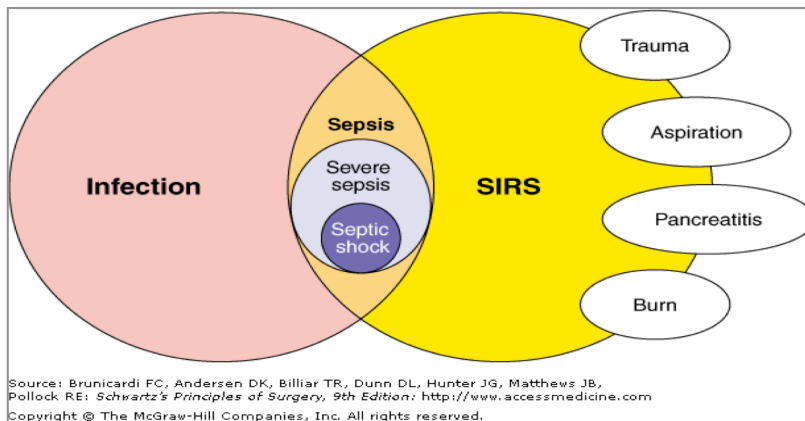
Infection is defined by:

1. Microorganisms in host tissue or the bloodstream
2. Inflammatory response to their presence.

Inflammatory Response:

Localized: Rubor, Calor, Dolor, Tumor, and functio laesa (loss of function).

Systemic: Systemic Inflammatory Response Syndrome (SIRS)



S.I.R.S.

Any Two of the Following Criteria:

1. Temperature: less than 36°C or greater than 38°C.
2. Heart Rate: greater than 90 beats per minute
3. Respiratory Rate: greater than 20 breaths per minute (Tachypnea)
4. WBC: less than 4000 cells/mm³ or greater than 12,000 cells/mm³

*Sepsis: SIRS plus evidence of local or systemic infection.

*Septic Shock: Sepsis plus end organ hypoperfusion.

Mortality of up to 40%

Note(s):

1- Trauma, Aspiration, Pancreatitis and burn could cause inflammation without infection
Calor, dolor, rubor, and tumor: Heat, pain, redness, and swelling. The four classical signs of inflammation, originally recorded by the Roman encyclopedist Celsus in the 1st century A.D.

2- Systemic inflammatory response: affects all the body systems
WBC < 4000 in immunocompromised patients

Introduction

- ✘ Surgery, trauma, non-trauma local invasion can lead to bacterial insult. Once present, bacteria, initiate the host defense processes. Inflammatory mediators (kinins, histamine, etc.) are released, compliment and plasma proteins are released, PMN's "polymorphonuclear leukocytes" arrive, etc
- ✘ Many established factors have a role in infection. These can be either surgical factors or patient-specific factors. Patient-specific factors can be further defined as either local or systemic

Surgical Risk Factors

- 1) Type of procedure "will mention it later"
- 2) Degree of contamination
- 3) Duration of operation
- 4) Urgency of operation*

SPREAD OF SURGICAL INFECTIONS

- 1) NECROTIZING INFECTION
- 2) ABSCESSSES
- 3) PHLEGMONS** AND SURPERFICIAL INFECTIONS
- 4) SPREAD OF INFECTIONS VIA THE LYMPHATIC SYSTEM
- 5) SPREAD OF INFECTION VIA BLOODSTREAM

Note(s):

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**Urgency of operation\*:**  
*urgent surgeries not like elective ones ,surgeons have time to scrub and be prepared.*

~~~~~  
Phlegmons:***early phase of abcess*
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## COMPLICATIONS OF SURGICAL INFECTION

- 1) Fistulas\*\*\* and sinus tract
- 2) Suppressed wound healing
- 3) Immunosuppression and superinfection
- 4) Bacteremia
- 5) Organ dysfunction Sepsis, and systemic inflammatory response syndrome

### Note(s):

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A fistula*** is an abnormal connection between anorgan, vessel, or intestine and another structure.Fistulas are usually the result of injury or surgery. It can also result from infection or inflammation.
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## CLINICAL FINDINGS AND DIAGNOSIS

1. **Physical examination: Warmth, erythema, induration, tenderness**
2. Laboratory findings General findings: Leukocytosis, acidosis, and signs of disseminated intravascular coagulation
3. Cultures
4. Imaging studies
5. Source of infection

## TREATMENT

- Incision and drainage “mostly with skin or mass lesions, e.g.: abscess”
- Excision “e.g.: sebaceous cyst, foreign body, diabetic foot”
- Antibiotics
- Nutritional support.

## Infection Types:

### Two main types:

**i. Community-Acquired**

**ii. Hospital-Acquired**

### Community-Acquired:

- Skin/soft tissue Cellulitis:
- Group A strep
- Carbuncles/furuncle: Staph aureus
- Necrotizing: Mixed
- Hidradenitis suppurativa: Staph aureus
- Lymphangitis: Staph aureus.

### **Note(s):**

- In appendicitis :Normal lucocytes, high neutrophils.

-Blood Cultures are done if the patient is febrile and sick but not after antibiotics, it will be useless

-Necrotizing fasciitis appears bubbly on CT scan.

- Examination: inspection eg: wasting of temporalis muscle.”  
(Temporalis Muscle Wasting: Loss of temporalis muscle mass commonly seen in cases of significant catabolism and/or generalized nutritional deficiency)

- Blood tests e.g.: - albumin to know the chronic status of the patient.

- Pre-albumin to know the current status of the patient

-When can we say this weight loss is significant? If it is More than 10 kg over the past 6 months.

## Cellulitis

- Definition: Diffuse infection with severe inflammation of dermal and subcutaneous layers of the skin.
- Diagnosis: Pain, Warmth, Hyperesthesia
- Treatment: Antibiotics.”
- Common Pathogens: Skin Flora (Streptococcus/Staphylococcus)



Cellulitis: observe the swollen leg.



Cellulitis Treatment: Antibiotics. “With observation by drawing borders around the affected area to check if there is a response to the treatment or not

## FURUNCLES AND CARBUNCLES

- ❖ Furuncles\* and carbuncles\*\* are cutaneous abscess that begin in skin glands and hair follicles.
- ❖ If the pilosebaceous apparatus\*\*\* becomes obstructed at the skin level, the development of a furuncle can be anticipated.
- ❖ A carbuncle is a deep-seated mass of fistulous tracts between infected hair follicles.

Furuncles are the most common surgical infections, but carbuncles are rare.

### Note(s):

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-Furuncles*: infect one hair follicle.

-Carbuncles**: fistulous and sinuses between a group of hair follicles

~~~~~  
-The sebaceous glands open into the hair follicles, and together these form the pilosebaceous apparatus\*\*\*



A **furuncle** is an acute, round, firm, tender, circumscribed, perifollicular staphylococcal pyoderma that usually ends in central suppuration.

**carbuncle** is two or more confluent furuncles with separate heads.

## HIDRADENITIS

Serious skin infection of the **axillae or groin** Consisting of multiple abscesses of the **apocrine sweat glands**. **The condition often becomes chronic**. The cause is unknown but may involve a defect of terminal follicular.



HIDRADENITIS

### TREATMENT:

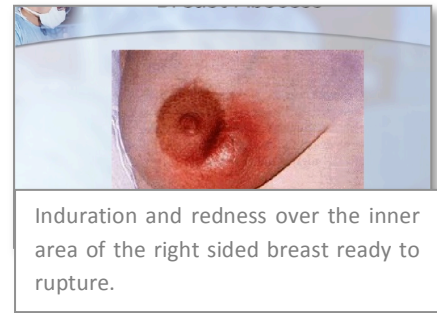
- ❖ **The classic therapy of furuncle is drainage, not antibiotics.**
- ❖ Invasive carbuncles must be treated by **excision and antibiotics**.
- ❖ Hidradenitis is usually treated **by drainage of the individual abscess and followed by careful hygiene**. Usually not improved by antibiotics, it needs **excision**.

### Lymphangitis (blister)

Lymphangitis arising from cellulitis produces red, warm, tender streaks 3-4 mm wide, spreads from the infection along lymphatic vessels to the regional lymph nodes.

## Breast Abscess

- Staphylococcal infection
- Usually post-partum
- MRSA (Methicillin-resistant Staphylococcus aureus ) is uncommon.



Induration and redness over the inner area of the right sided breast ready to rupture.

## Abscess

Definition: Infectious accumulation of purulent material (Neutrophils) in a closed cavity

Diagnosis: **Fluctuation test: Moveable and compressible**

Treatment: Drainage

### Note(s):

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 -Lymphangitis:infection spreads by lymphatic channels,in examination you feel it as a cord like

-Breast Abscess usually post-partum in lactation.
 Rx: Treatment: mature Abscess: Incision and drainage. Some surgeons try antibiotic if the abscess is not mature enough or if there is no fluctuation when they do the examination..

-If there is evidence of cellulitis(skin changes),give antibiotics,but if the patient didn't respond think of MRSA

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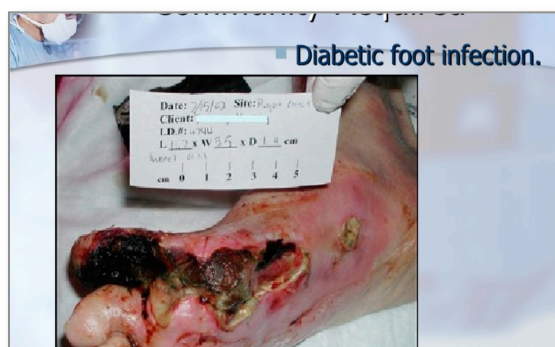
Diffuse+subcutaneous abscess, different than furuncle(not area of hair follicle)

## Peri-rectal abscess

Results from infection of the **anal crypts**. Can be extensive .Can result in bacteremia

Treatment: Incision and drainage.

## Diabetic Foot Infection



Diabetic foot infection secondary to depressed immunity, ends up by amputation.



# Hand Infections:

## 1-Paronychia

An inflammatory reaction involving the **folds of the skin surrounding the fingernail**. It is characterized by acute or chronic **purulent, tender, and painful swellings** of the tissues around the nail, caused by **an abscess** of the nail fold. The pathogenic yeast causing paronychia is most frequently **Candida albicans**. The causative bacteria are usually **Staphylococcus, Pseudomonas aeruginosa, or Streptococcus**.



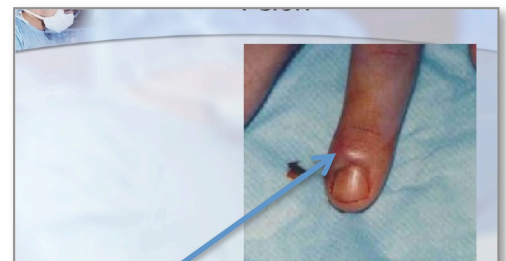
Paronychia: infection of the skin fold around the nails

Treatment: **Incision and drainage, if not responding antibiotic.**

## 2-Felon

- ❖ Closed-space infections of the fingertip pulp.
- ❖ Treatment :**Incision**
- ❖ Paronychia can lead to felon

Both can lead to **tenosynovitis\***



Felon.

\* **Tenosynovitis** is the inflammation of the fluid-filled sheath (called the synovium) that surrounds a tendon. Symptoms of tenosynovitis include pain, swelling and difficulty moving the particular joint where the inflammation occurs. When the condition causes the finger to "stick" in a flexed position, this is called "stenosing" tenosynovitis, commonly known as "trigger finger".

# DIFFUSE NECROTIZING INFECTIONS

Particular dangerous, difficult to diagnose, extremely toxic, spread rapidly, often leading to limb amputation.

## **Note(s):**

DIFFUSE NECROTIZING INFECTIONS limited to upper and lower limbs most of the time.

## **Pathogenic factors:**

1. Anaerobic
2. Wound Bacterial exotoxins
3. Bacterial synergy “multiple”
4. Thrombosis of nutrient bridging vessels is a result of necrotizing infection.

## **Classification:**

### **1-Clostridial** “mostly skin and soft tissue”

- **Necrotizing cellulitis**
- **Myositis**

### **2-Nonclostridial** “mostly deep to the fascia”

- **Necrotizing fasciitis** (deep infection)
- **Streptococcal gangrene** (most common)

## **Note(s):**

Treatment of clostridial infections: broad spectrum antibiotics till you see the response.

Crepitant abscess in clostridial infections is <40% or less (rare)

## **Clostridial Infections:**

- 1) They are fastidious anaerobes.
- 2) A broad spectrum of disease is caused by clostridia.
- 3) On gram-stain they appear as relatively large, gram-positive, rod-shaped bacteria.

**Clinical Findings:** Crepitant abscess or cellulitis Invasion is usually superficial to the deep fascia and may spread very quickly, producing discoloration. Delayed debridement of injured tissue after devascularizing injury is the common setting.

## Gas Gangrene

- \* **Clinical Findings:** Severe pain suggests extension into muscle compartments (**myositis**).
- \* The disease progresses rapidly, with loss of blood supply to the infected tissue.
- \* Profound shock can appear early, rapidly leading to organ dysfunction.
- \* **Air bubbles** often visible **on plain radiograph**. Crepitus may be present, but not reliable to differentiation.

### Note(s):

Patient presented with severe pain>> think about myositis.

Gas Gangrene spreads by blood, there is a quick loss of blood that if it's not treated the patient dies or end by septic shock



Gas Gangrene: Skin changes + Blisters

## Nonclostridial Infections

- \* Caused by multiple nonclostridial bacterial pathogens. Microaerophilic streptococci, staphylococci, aerobic gram-negative bacteria, and anaerobes, especially peptostreptococci and bacteroides.
- \* **Clinical Findings:** Usually begins in a localized area such as a puncture wound, leg ulcer, or surgical wound. Externally, **hemorrhagic bullae are usually the first sign of skin death**. The skin is anesthetic and crepitus is occasionally present. The fascial necrosis is usually wider than the skin appearance indicates.
- \* At operation, the finding of edematous, dull-gray, and necrotic fascia and subcutaneous tissue confirm the diagnosis.

**Note(s):** Crepitant abscess in Nonclostridial infections is **>40%**.

Treatment in clostridial and Nonclostridial infections is **debridement, and oxygenation to enhance blood supply.**



Necrotizing soft tissue infection

## Streptococcal gangrene Group A

- ✘ Streptococcus is a bacterium frequently found in the skin and throat.
- ✘ Streptococcal gangrene is uncommon
- ✘ The **sudden onset** of severe pain is the most common presenting symptom, usually in an extremity associated with a wound.
- ✘ **Fever** and other signs of systemic infection are frequently present at the time of presentation.
- ✘ **Shock** and **renal dysfunction** are usually present within 24 hours.

### **Note(s):**

Usually wound infections appear 7 days after the surgery **except** Streptococcal gangrene Group A (non clostridial) and clostridial infections which appear 1 day after

### **TREATMENT:**

1. Complete debridement and depress tight fascial compartment. Amputation.
2. **Broad-spectrum antibiotic therapy**
3. Resuscitative therapy
4. Treat diabetes mellitus aggressively
5. Hyperbaric oxygenation inhibit bacterial invasion but does not eliminate the focus of infection.

## **Biliary Tract:**

Usually result from obstruction

**Usual suspects: E. coli, Klebsiella, Enterococci**

## **Acute Cholecystitis:**

GB empyema

## **Ascending cholangitis**

Diagnosis: **ultrasound** .Treatment: **antibiotics, relieve the obstruction.**

## Peritonitis

Causes: **appendicitis, Acute Cholecystitis, ...etc**

Diagnosis: **history and examination**

Treatment: **treat the underlying cause**

**Viral:** Hepatitis, HIV/AIDS

## Tetanus:

C. tetani infection “ Lock-jaw”

Caused by exotoxin, Treatment: **immunization.**

### **Note(s):**

Always check tetanus vaccine if trauma happens

## Post-Operative Infections:

❖ Fever After Surgery

### The “Five W’s” “possible causes for postoperative fever”:

- 1) **Wind:** Atelectasis
- 2) **Water:** UTI (Urinary Track Infection)
- 3) **Walking:** DVT (Deep Vein Thrombosis)
- 4) **Wonder Drug:** Medication Induced
- 5) **Wound:** Surgical Site Infection

Other causes of post-operative fever include:

- 6) Blood transfusion ·
- 7) Preoperative misdiagnosis “pneumonia”
- 8) **Malignant hyperthermia\*** “one of the important and most common causes, very important to ask about it in the family history”

### **Note(s):**

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Wind: Atelectasis=collapse of the lungs.

Infections after surgery:

1st day: drug reaction or already has infection not discovered by surgeons.

2nd day: pneumonia, thrombophlebitis.

3rd_5th day: Urinary tract infections.

5th_7th day: pulmonary embolism+vein thrombosis

7th-10th day: wound infection except group A streptococcus

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\*Malignant hyperthermia is disease passed down through families that causes a fast rise in body temperature (fever) and severe muscle contractions when the affected person gets general anesthesia

# Surgical Site Infections “SSI”

3rd most common hospital infection:

- ❖ Incisional
  - Superficial
  - Deep
- ❖ Organ Space:
  - Generalized (peritonitis)
  - Abscess

## Note(s):

Examine signs of infection:  
could be superficial or deep  
which reaches the organ.

## SSI-Infection:

- ✘ Definition: Surgical sites are considered infected when there are Systemic and local signs of inflammation.
- ✘ Bacterial counts  $\geq 10^5$  cfu/mL. Purulent versus non-purulent
- ✘ The length of stay for the patient and economic effects of the hospital stay are important factors to consider in SSIs.
- ✘ Note that Surgical wound infection is SSI

## 1- Superficial Incisional SSI:

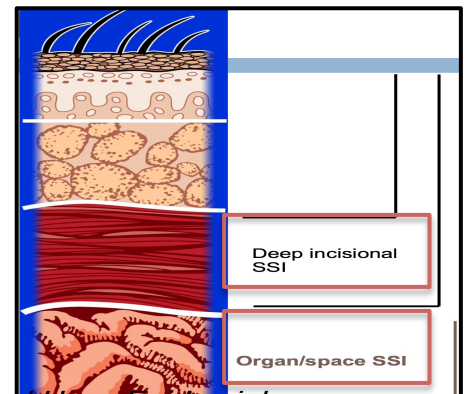
Infection occurs within 30 days after the operation and involves only skin or subcutaneous tissue of the incision



Subcutaneous Tissue

## 2- Deep Incisional SSI:

A more serious SSI. Extends past the superficial layer. The infection occurs within 30 days post-operation only if no implant is left in place or within 1 year if implant(ex:silicone) is in place and the infection appears to be related to the operation and the infection involves the deep soft tissue, which include the fascia and muscle layers.



## 3- Organ/Space SSI

The most extensive of these surgical infections involves the organs and the space surrounding the organs. These infections can occur within 30 days post-op if no implant is left in place or within 1 year if an implant is in place and the infection appears to be related to the operation and the infection involves any part of the anatomy, other than the incision, which was opened or manipulated during the operation

## SSI – Risk Factors:

| Operation Factors                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Patient Characteristics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> <li>1. Duration of surgical scrub.</li> <li>2. Maintenance of body temperature.</li> <li>3. The use of skin antiseptics.</li> <li>4. Preoperative shaving.</li> <li>5. Duration of operation.</li> <li>6. Antimicrobial prophylaxis.</li> <li>7. Operating room ventilation.</li> <li>8. inadequate sterilization of instruments.</li> <li>9. Foreign material at surgical site.</li> <li>10. Surgical drains.</li> <li>11. Surgical technique, Poor surgical technique includes: <ul style="list-style-type: none"> <li>❖ Poor hemostasis.</li> <li>❖ Failure to obliterate dead space.</li> <li>❖ Tissue trauma.</li> </ul> </li> </ol> | <ol style="list-style-type: none"> <li>1. Advanced age</li> <li>2. Diabetes: HbA1C and SSI<br/>Glucose &gt; 200 mg/dL postoperative period (&lt;48 hours)</li> <li>3. Nicotine use: delays primary wound healing</li> <li>4. Steroid use: controversial</li> <li>5. Malnutrition: no epidemiological association</li> <li>6. Obesity: 20% over ideal body weight</li> <li>7. Prolonged preoperative stay: surrogate of the severity of illness and comorbid conditions</li> <li>8. Preoperative nares colonization with Staphylococcus aureus:</li> <li>9. significant association</li> <li>10. Perioperative transfusion: controversial</li> <li>11. Coexistent infections at a remote body site</li> <li>12. Altered immune response</li> </ol> |

## Perioperative Glucose Control:

Patients with a blood sugar > 300 mg/dL during or within 48 hours of surgery had more **than 3times the likelihood of a wound infection.**

## Pre-operative Shaving

**Shaving the surgical site with a razor induces small skin lacerations**

Potential sites for infection

- ✘ Disturbs hair follicles which are often colonized with S.aureus.
- ✘ Risk greatest when done the night before.
- ✘ **Patient education** :Be sure patients know that they should not do you a favor and shave before they come to the hospital!

## Prophylactic Antibiotics:

- ✘ Antibiotics given "IV" for the purpose of preventing infection when infection is not present but the risk of postoperative infection is present.
- ✘ Decreases bacterial counts at surgical site
- ✘ **Given within 30 minutes prior to starting surgery**
- ✘ Vancomycin 1-2 hours prior to surgery
- ✘ Redose for longer surgery
- ✘ Do not continue beyond 24 hours

## Surgical site prevention:

- Use antibiotics appropriately
- Maintain normal Body temp
- Maintain normal Blood glucose
- Optimize oxygen tension
- Avoid shaving Site

## Treatment

**Incisional:** open surgical wound, antibiotics for cellulitis or sepsis

**Deep/Organ space:** Source control, antibiotics for sepsis

### **Note(s):**

Albumin<5 is a source of infection

### **Preoperative preparations**

- Patient should stop **smoking** 6 weeks prior to the surgery
- Measure the patient's **temperature**
- Take **shower** 1 day before the surgery
- **Weight reduction** is advised



## Types of surgery

|                           |                                                    |              |
|---------------------------|----------------------------------------------------|--------------|
| <b>Clean</b>              | <b>Hernia repair<br/>breast biopsy</b>             | <b>1.5%</b>  |
| <b>Clean-Contaminated</b> | <b>Cholecystectomy<br/>planned bowel resection</b> | <b>2-5%</b>  |
| <b>Contaminated</b>       | <b>Non-preped bowel resection</b>                  | <b>5-30%</b> |
| <b>Dirty/infected</b>     | <b>perforation, abscess</b>                        | <b>5-30%</b> |

**Note(s):**

**Hernia** is a clean surgery. Antibiotics aren't needed unless there is foreign body

**Not important\***

## Occupational Blood Bourne Virus Infections

|                                   | <b>HBV</b> | <b>HCV</b> | <b>HIV</b>  |
|-----------------------------------|------------|------------|-------------|
| <b>Risk from<br/>Needle stick</b> | <b>30%</b> | <b>2%</b>  | <b>0.3%</b> |
| <b>Chemoprophylaxis</b>           | <b>Yes</b> | <b>No</b>  | <b>Yes</b>  |
| <b>Vaccine</b>                    | <b>Yes</b> | <b>No</b>  | <b>No</b>   |

**TABLE 4.2** Screening for sepsis and severe sepsis

|                                                                                                                                                                                                                           |                                                                                                                                                                                                                                  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Are any two of the following present?</b>                                                                                                                                                                              |                                                                                                                                                                                                                                  |
| <ul style="list-style-type: none"> <li>• Temperature &lt; 36 or &gt; 38.3°C</li> <li>• Heart rate &gt; 90bpm</li> <li>• WCC &gt; 12 or &lt; 4 × 10<sup>9</sup>/l</li> </ul>                                               | <ul style="list-style-type: none"> <li>• Respiratory rate &gt; 20/min</li> <li>• Acutely altered mental state</li> <li>• Hyperglycaemia in the absence of diabetes</li> </ul>                                                    |
| <b>If yes:</b>                                                                                                                                                                                                            |                                                                                                                                                                                                                                  |
| <b>Does the patient have a history or signs suggestive of a new infection?</b>                                                                                                                                            |                                                                                                                                                                                                                                  |
| <ul style="list-style-type: none"> <li>• Cough/sputum/chest pain</li> <li>• Abdominal pain/distension/diarrhoea</li> <li>• Line infections</li> </ul>                                                                     | <ul style="list-style-type: none"> <li>• Dysuria</li> <li>• Headache with neck stiffness</li> <li>• Cellulitis/wound infection/septic arthritis</li> </ul>                                                                       |
| <b>If yes, patient has SEPSIS</b>                                                                                                                                                                                         |                                                                                                                                                                                                                                  |
| <b>Are there any signs of organ dysfunction?</b>                                                                                                                                                                          |                                                                                                                                                                                                                                  |
| <ul style="list-style-type: none"> <li>• SBP &lt; 90 mmHg or MAP &lt; 65 mmHg</li> <li>• Urine output &lt; 0.5 ml/kg/hr for 2 hrs</li> <li>• INR &gt; 1.5 or APTT &gt; 60s</li> <li>• Bilirubin &gt; 34 mmol/l</li> </ul> | <ul style="list-style-type: none"> <li>• Lactate &gt; 2 mmol/l</li> <li>• New need for oxygen to keep SpO<sub>2</sub> &gt; 90%</li> <li>• Platelets &lt; 100 × 10<sup>9</sup>/l</li> <li>• Creatinine &gt; 177 mmol/l</li> </ul> |
| <b>NO: Treat for SEPSIS:</b>                                                                                                                                                                                              | <b>YES: Patient has SEVERE SEPSIS</b>                                                                                                                                                                                            |
| <ul style="list-style-type: none"> <li>• Oxygen</li> <li>• Blood cultures</li> <li>• IV antibiotics</li> <li>• Fluid therapy</li> <li>• Reassess for SEVERE SEPSIS with hourly observations</li> </ul>                    | Start<br>SEVERE SEPSIS CARE PATHWAY<br>(Table 4.3 <a href="#">🔗</a> )                                                                                                                                                            |

| Organism                                                                                  | First choice                                  | Alternative                           |
|-------------------------------------------------------------------------------------------|-----------------------------------------------|---------------------------------------|
| Methicillin-sensitive <i>Staphylococcus aureus</i> (MSSA)                                 | Flucloxacillin                                | Clarithromycin                        |
| Methicillin-resistant <i>Staphylococcus aureus</i> (MRSA)*                                | Vancomycin                                    | Linezolid<br>Daptomycin               |
| Coagulase-negative staphylococci                                                          | Vancomycin                                    | Linezolid<br>Daptomycin               |
| <i>Streptococcus pneumoniae</i>                                                           | Benzylpenicillin                              | Clarithromycin                        |
| <i>Streptococcus pyogenes</i> (group A β-haemolytic streptococcus)                        | Benzylpenicillin<br>Clindamycin               | Clarithromycin                        |
| Enterococci                                                                               | Amoxicillin                                   | Vancomycin                            |
| Bacteroides species                                                                       | Metronidazole                                 | Co-amoxiclav                          |
| <i>Escherichia coli</i><br>1. Sepsis, including bacteraemia<br>2. Urinary tract infection | Piperacillin-Tazobactam<br>Trimethoprim       | Meropenem<br>Co-amoxiclav             |
| <i>Haemophilus influenzae</i>                                                             | Amoxicillin                                   | Co-amoxiclav                          |
| <i>Klebsiella</i> spp                                                                     | Co-amoxiclav                                  | Meropenem                             |
| <i>Proteus</i> species                                                                    | Co-amoxiclav                                  | Meropenem                             |
| <i>Pseudomonas aeruginosa</i>                                                             | Piperacillin-Tazobactam                       | Meropenem                             |
| <i>Clostridium</i> spp                                                                    | Benzylpenicillin + metronidazole              | Metronidazole                         |
| <i>Clostridium difficile</i>                                                              | Stop predisposing antibiotic<br>Metronidazole | Vancomycin, oral,<br>re-treat relapse |

| Type of Infections                                                                                                                   | Antimicrobial                                                                                | Alternative                                                                                               |
|--------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| <b>Chest infection</b><br>Uncomplicated<br>Community-acquired pneumonia<br>'Aspiration' pneumonia<br>Hospital-acquired/postoperative | Amoxicillin<br>Benzyl penicillin + clarithromycin<br>Co-amoxiclav<br>Piperacillin-tazobactam | Clarithromycin<br>Levofloxacin + clarithromycin<br>Levofloxacin + metronidazole<br>Meropenem + vancomycin |
| <b>Urinary tract infection</b><br>'Lower' infection<br>Acute pyelonephritis<br>Prostatitis                                           | Trimethoprim<br>Co-amoxiclav<br>Ciprofloxacin                                                | Amoxicillin<br>Gentamicin                                                                                 |
| <b>Wound infection</b><br>Cellulitis<br>Abscess                                                                                      | Penicillin + flucloxacillin<br>Drain collection                                              | Clarithromycin<br>Flucloxacillin                                                                          |
| <b>Intra-abdominal sepsis</b>                                                                                                        | Amoxicillin + metronidazole + gentamicin                                                     | Meropenem                                                                                                 |
| <b>Cholecystitis-cholangitis</b>                                                                                                     | Co-amoxiclav                                                                                 | Meropenem                                                                                                 |
| <b>Pelvic inflammatory disease</b>                                                                                                   | Azithromycin + metronidazole + gentamicin                                                    | Doxycycline + piperacillin-tazobactam                                                                     |
| <b>Amputations and gas gangrene</b>                                                                                                  | Benzylpenicillin + metronidazole                                                             | Metronidazole                                                                                             |
| <b>Septicaemia and septic shock</b>                                                                                                  | Amoxicillin + metronidazole + gentamicin/ciprofloxacin                                       | Piperacillin-tazobactam, meropenem                                                                        |
| Severe <i>Pseudomonas</i> infections                                                                                                 | Piperacillin-tazobactam + gentamicin                                                         | Meropenem ± gentamicin                                                                                    |
| <b>Candida</b> sepsis                                                                                                                | Fluconazole                                                                                  | Caspofungin                                                                                               |

| Organisms                                    | Properties, Common Infections & Treatment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1. Staphylococci (Gram +ve)</b>           | <ul style="list-style-type: none"> <li>Inhabitants of <u>skin</u></li> <li>Sensitive to penicillinase-resistant <math>\beta</math>-lactam antibiotics</li> <li>MRSA is resistant to penicillinase-resistant <math>\beta</math>-lactam antibiotics</li> <li>Infection characterized by <b>suppuration</b> (thick pus formation): <ul style="list-style-type: none"> <li>Staph. aureus: <b>Surgical Site Infection (SSI)</b>, nosocomial, superficial infections</li> <li>Staph. epidermidis: opportunistic e.g. wound (SSI), <b>endocarditis</b> (especially with prosthetic valves)</li> </ul> </li> <li>Rx: non-MRSA → <b>cloxacillin, oxacillin</b></li> <li>MRSA = <b>Vancomycin</b> Ⓢ</li> </ul> |
| <b>2. Streptococci (Gram +ve)</b>            | <ul style="list-style-type: none"> <li>Aerobes/anaerobes</li> <li>Flora of the mouth pharynx, bowel</li> <li>1. Streptococcus pyogenes (<math>\beta</math> hemolytic): <b>90%</b> of infections e.g. lymphangitis, cellulitis, rheumatic fever</li> <li>2. Strep. viridans: endocarditis, urinary infection</li> <li>3. Enterococci: urinary infection, intra-abdominal infections</li> </ul>                                                                                                                                                                                                                                                                                                        |
| <b>3. Gram -ve Rods</b>                      | <ul style="list-style-type: none"> <li>Most fall into the family Enterobacteriaceae</li> <li>Most are facultative anaerobic</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>a. Enterobacteriaceae</b>                 | <p><b>Escherichia, Proteus, and Klebsiella</b></p> <ul style="list-style-type: none"> <li>Susceptible to a broad variety of antibiotics e.g. 2<sup>nd</sup> generation cephalosporins</li> <li>Common in mixed surgical infections</li> </ul> <p><b>Enterobacter, Morganella, Providencia, and Serratia</b></p> <ul style="list-style-type: none"> <li>Greater resistance to antibiotics</li> <li>Rx: 3<sup>rd</sup> generation cephalosporins, extended-spectrum penicillins, monobactam, carbapenem, aminoglycosides or quinolone</li> </ul>                                                                                                                                                       |
| <b>b. Pseudomonas, Acinetobacter species</b> | <ul style="list-style-type: none"> <li>Obligate aerobic gram -ve</li> <li>Hospital-acquired Ⓢ: pneumonia, peritoneal cavity or severe soft tissue infections</li> <li>Rx: <b>ceftazidime</b> (anti-pseudomonal 3<sup>rd</sup> gen cephalosporin), cefepime (4<sup>th</sup> gen cephalosporin), <b>imipenem/cilastatin</b>, meropenem, <b>ciprofloxacin</b>, acylureidopenicillin, or an aminoglycoside</li> </ul>                                                                                                                                                                                                                                                                                    |
| <b>4. Anaerobes (all Ⓢ)</b>                  | <ul style="list-style-type: none"> <li>Inhabitants of GIT (colon) &amp; the mouth</li> <li>Most common: <b>Bacteroides fragilis</b></li> <li>Rx: <b>metronidazole, clindamycin</b>, imipenem, meropenem, ertapenem, the combinations ticarcillin/clavulanate, ampicillin/sulbactam &amp; piperacillin/tazobactam</li> </ul>                                                                                                                                                                                                                                                                                                                                                                          |
| <b>5. Clostridia (Gram +ve)</b>              | <ul style="list-style-type: none"> <li>Anaerobe, rod-shaped microorganisms</li> <li>Live in bowel &amp; soil</li> <li>Produce <b>exotoxin</b> for pathogenicity</li> <li>Most important Ⓢ: <ul style="list-style-type: none"> <li>Cl. perfringens, Cl. septicum: <b>gas gangrene</b></li> <li>Cl. tetani: <b>tetanus</b></li> <li>Cl. difficile: <b>pseudomembranous colitis</b></li> </ul> </li> </ul>                                                                                                                                                                                                                                                                                              |

## SUMMARY

1. Inflammatory response: localized or systemic.
2. SIRS : any 2 of the following :
  - Temperature.
  - Heart rate.
  - Respiratory rate
  - WBC
3. Spread of surgical infection through :
  - Lymphatic system
  - Blood stream
4. Treatment :
  - Excision, Incision and drainage , Antibiotics and Nutritional support
5. infection types :
  - community aquired and hospital aquired

### 6. community aquired infections:

Cellulitis: **skin flora - antibiotic**

carbuncles\furuncle:

carbuncle is a deep –seated mass of fistulous tracts between infected hair follicles - **treated by excision and antibiotics.**

furuncle **the most common surgical infections – treatment is drainage**

necrotizing,

hidradenitis suppurative: treated by **drainage** of the individual abscess and followed by **careful hygiene.**

and lymphadenitis

### 7. hand infections: **Paronychia and Felon**

Both can lead to **tenosynovitis.**

### 8. post operative infections

- \* fever and five Ws
- \* Wind: Atelectasis
- \* Water: UTI
- \* Walking: DVT
- \* Wonder Drug: Medication Induced
- \* Wound: Surgical Site Infection

## IMPORTANT NOTES FROM EXTERNAL RESOURCES

### Notes

Essential surgery  
Problems, diagnosis and  
management  
"recommended book"

All the tables from it =)  
Except the last one, it is from Raslan's textbook

## Questions

- 1) A 40 yo female underwent left breast mastectomy presented with left arm edema ?
  - a. Obstruction of lymphatic drainage
  - b. Blood vessel damage
  - c. Skin infection
  - d. Complication of drugs
  
- 2) Patient has wound and came to the ER the registrar said for the intern suture it, the intern should check for which of the following vaccinations ?
  - a. Tetanus
  - b. Hepatitis
  - c. Influenza
  
- 3) What is the most surgical infection?
  - A - lymphadenitis
  - B - cellulitis
  - C - furuncle
  - D - necrotizing

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#### **Answers:**

1<sup>st</sup> Question: A

2<sup>nd</sup> Question: A

3<sup>rd</sup> Question: C