Goal: Look for sources that require surgery in patients that present with severe infections.

Source Control:

- Draining infected fluid collection
- Debridement of infected solid tissue and removing foreign bodies
- Correct anatomic derangement

We will focus on four diseases that require emergent surgical intervention

**Necrotizing soft tissue infections (necrotizing fasciitis)**

A necrotizing soft tissue infection is a soft tissue infection with necrotic changes on pathology.

A diverse group of diseases. Can involve:

- Dermis, subcutaneous tissue, fascia, muscle

Many names have been used depending on the organism and location. It is more important to understand that these infections are all soft tissue infections with necrotic changes and they require immediate surgical treatment. Patients often have co-morbid conditions. The diagnosis and treatment is in the operating room.

**Clinical**

- Signs of soft tissue infection with systemic toxicity
- Severe pain (out of proportion to exam)
- Hard Signs (Easy to make the diagnosis now – but, a little late)
  - Bullae, crepitus, gas on xrays, hypotension, skin necrosis

**Diagnosis**

- Obvious cases go straight to the operating room
- Diagnosis of early necrotizing infection can be difficult

Radiographs are often used. Remember that soft tissue gas is not seen with *Streptococcus pyogenes*. CT and MRI can visualize facial planes. Patients are often too sick to get these studies. Gas rules in disease.

Preliminary data on using a laboratory risk score looks promising (LRINEC score). Consider using it; especially if your surgeons like it. A score of 6 or greater increases the risk of NSTI.

Involving your surgeons early if you are in doubt. Call them when you start thinking about calculating a LRINEC score. Early diagnosis is
difficult and experience with the disease is very important. Consider a necrotizing infection in your sick cellulitis cases; remember cellulitis does not cause septic shock.

Rx

**Early and aggressive surgical intervention**
- Decreased bacterial inoculum
- Decreased inflammatory response
- Improved survival

**Broad Spectrum Antibiotics**
- Life threatening infection: Must cover MRSA, group A strep, and enteric gram negatives
- Vancomycin + Piperacillin/Tazobactam + Clindamycin

**Supportive care**

Severe kidney infections

The majority of urinary tract infections are uncomplicated and respond well to short courses of empiric antibiotics. Occasionally, patients present or rapidly develop sepsis or septic shock. It is imperative for the ED physician to perform an appropriate work up which includes imaging and early urologic consultation. An infected obstructed stone (“pus under pressure”) can rapidly kill a young-healthy patient.

Pyelonephritis is usually diagnosed by clinical and lab findings (fever, flank pain, and pyuria). It responds quickly to antibiotics (48-72 hours). Most patients do not require imaging or specialty care.

Image patients (ultrasound or CT) that present with sepsis or do not improve after 48 hours of appropriate therapy. Consider imaging patients that are sick enough to require admission for pyelonephritis.

| Laboratory risk indicator for necrotizing fasciitis |
|---------------------------------|--------|
| **Value**                       | **LRINEC score** |
| C-reactive protein              |         |
| * <15                           | 0       |
| * ≥150                          | 4       |
| WBC count                       |         |
| * <15                           | 0       |
| * 15-25                         | 1       |
| * >25                           | 2       |
| Hemoglobin                      |         |
| * >13.5                         | 0       |
| * 11-13.5                       | 1       |
| * <11                           | 2       |
| Sodium                          |         |
| * ≥135                          | 0       |
| * <135                          | 2       |
| Creatinine                      |         |
| * ≤1.6                          | 0       |
| * >1.6                          | 2       |
| Glucose                         |         |
| * ≤180                          | 0       |
| * >180                          | 1       |

What am I looking for on imaging?
- Obstruction
- Abscess
- Necrotizing infections

We are imaging patients to look for complications that require an intervention. The obstruction must be relieved, the abscess drained, and the necrotizing infection debrided. Necrotizing infections (emphysematous pyelonephritis) typically occur in the setting of obstruction and the patients are often diabetic. Occasionally a nephrectomy is life saving.

**RX**
- **Antibiotics**
  - Cover enteric gram negative organism (Quinolone, 3rd/4th generation cephalosporin, pip/tazo, aminoglycoside, etc…)
- **Hemodynamic resuscitation**
  - Fluids, Pressors
- **Surgical drainage**
  - Percutaneous drainage, nephrectomy
Epidural abscess
An epidural abscess is a collection of pus in between the dura and bone (vertebral column in spinal epidural abscess). The disease is uncommon (.2 – 2 cases / 10,000 hospital admissions) and there is a high potential for permanent neurologic disabilities. Many cases are missed on initial presentation. However, prompt diagnosis and treatment are the most important factors in outcome.

Pathogenesis:
Bacteria can gain access to the epidural space via:
1) Hematogenous spread, 2) Contiguous spread, 3) Direct inoculation

The culprit organisms
❖ *Staphylococcus aureus*, *Streptococci spp*, *Aerobic gram-negative rods*

### Risk Factors

<table>
<thead>
<tr>
<th>Bacteremia</th>
<th>Immunocompromise</th>
<th>Direct Inoculation</th>
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</thead>
<tbody>
<tr>
<td>IVDA</td>
<td>Diabetes</td>
<td>Penetrating injuries</td>
</tr>
<tr>
<td>CVC</td>
<td>Chronic systemic diseases</td>
<td>Decubitus ulcers</td>
</tr>
<tr>
<td>Endocarditis, skin infections, UTI, etc...</td>
<td>Alcoholism</td>
<td>Epidural analgesia, spinal surgery</td>
</tr>
</tbody>
</table>

### Clinical Features

The classic triad of fever, back, pain and neurologic deficits is rare. However, most patients will present with at least one of the three.

✓ **Pain is the most consistent feature**
❖ Midline (percussion tenderness), not relieved when lying down
✓ Fevers are variable
❖ Presence of fever is important, lack of fever is not helpful
✓ Neurologic abnormalities present late

### Diagnosis:

Early recognition is difficult because of the infrequency of the disease and the non-specific nature of early symptoms. Not considering the diagnosis is often the reason why these infections are missed.

<table>
<thead>
<tr>
<th>MRI with contrast</th>
<th>CT with IV contrast</th>
<th>CT Myelogram</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study of choice</td>
<td>No other option (pacemaker, cochlear implant)</td>
<td>Rarely done</td>
</tr>
</tbody>
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**Rhinocerebral zygomycosis (Mucormycosis)**

An infection that originates in the paranasal sinuses and extends to the brain. Most commonly affects patients with diabetes who are in DKA. However, there have been a few cases in immunocompetent individuals. Early diagnosis is critical for a better outcome. The zygomycetes species are relatively resistant to anti-fungal treatment and thus aggressive surgical debridement is the cornerstone of therapy. The diagnosis is suspected on clinical grounds and confirmed with radiographic studies and histopath.

**Pathogenesis**

The organism likes acidic and high glucose conditions. Thus, a patient with DKA is an ideal host. The fungus is angioinvasive; ischemia and infarction of infected tissue is characteristic. The onset is often rapid. Spores are inhaled and deposit themselves in the nares. The infection then spreads to the paranasal sinuses, orbits, and the brain.

**Risk Factors**

- Diabetes/DM, metabolic acidosis
- Hematologic malignancies, organ transplantation
- Deferoxamine and iron overload

**Symptoms**

- Acute sinusitis
- Facial anesthesia
- *Facial pain* or ocular pain

**Signs**

- Necrotic lesions (not always present)
- Ocular involvement
- Cavernous sinus thrombosis

**Diagnosis**

- Radiographic findings
  - Intense inflammation
  - Unilateral nasal mucosal inflammation and then bone erosion/extrasinus extension

- Endoscopic evaluation and biopsy
  - Emergent evaluation by ENT

**Rx**

- Removing necrotic and devitalized tissue
- Antifungal therapy
- Correction of immunosupression and metabolic status
Select References and Further Reading


