

DIAGNOSIS OF INFECTION

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The prompt diagnosis of infection is vitally important to help reduce the patient's overall morbidity and in certain instances to preserve limbs. Few conditions share the same potential risk from a medicolegal standpoint as well. Even with the multitude of high-tech modalities and tests available today, the diagnosis of infection primarily rests in the clinical judgement of the clinician. This may create a certain degree of anguish on the part of the doctor who may prefer some mechanical means of assessing a patient with a troubling condition. Thus, the task is not always an easy one, especially when the surgeon is viewing one of his own patients.

When one is evaluating a patient with a potential infection three things should be contemplated. Certainly, the first consideration is whether or not infection is present at all. Many times this will be obvious. Secondly, one would like to try and determine what might be the potential organisms creating the infection so as to better direct the initial antibiotic therapy. Remember, it will usually take 48 hours before final culture and sensitivity results will be available and one would like to ensure adequate antibiotic coverage during this crucial period. Furthermore, one needs to formulate an idea as to the extent of the infection; particularly whether or not the infection is confined to the lower extremity or if the patient has sustained a septicemia.

LOCAL SIGNS

The classic cutaneous hallmarks of infection are redness, edema, and an increased temperature. Just as these indicators can be used to help in the diagnosis of infection, one may also use these findings to monitor the progress of the patient during recovery. Experienced surgeons will note that all of these indicators may be present in a patient several days postoperatively, especially

when there is a hematoma. However, the key determinant is the *intensity* of each. Those patients with infection will exhibit a greater reaction which will tend to sustain itself despite appropriate local care measures.

Edema may be localized or involve the entire extremity. Obviously the extent is a reflection of the type and severity of the infection. An important point is whether or not the swelling is fluctuant. Fluctuant swelling may suggest an abscess, gas, or possibly a hematoma. One way to monitor edema is by observing the skin lines. Swelling may obliterate normal skin lines, but as these features return one may generally presume that the patient is responding to therapy.

Variable degrees of erythema may be demonstrated by the patient during the course of the infection. Initially the skin will be a very bright or "angry" red and will generally assume a more violaceous hue with a resolution of the infectious process. As mentioned previously, a post-surgical wound may exhibit certain degrees of redness at the first dressing change. However, the erythema in this instance is usually more confined to the peri-incisional areas and of a lesser intensity.

Coincident with edema and erythema will be an increase in the temperature of the part. These symptoms will reflect the extent and severity of the infection and are best evaluated by a comparison to the contralateral extremity. Postoperatively and post-traumatically a certain amount of localized warmth is expected, particularly in the presence of hematoma.

One must remember that the degree of inflammatory changes exhibited is dependent on the vascular and immune status of the patient, and in some instances the particular bacteria involved. Patients with peripheral vascular disease, the elderly, or those with chronic disease states may not develop the same intensity of

changes seen in normal healthy adults. One must temper the evaluation with an understanding of the individual patient's overall condition. Furthermore, a chronic infection, particularly when gram negative bacteria are involved may be more indolent.

One of the most notable findings in a patient who presents with an infection is that there is usually some form of skin compromise. The skin is the body's first line of defense against infection and one generally looks for the portal of entry for the bacteria. Should cutaneous compromise be present then the wound must be evaluated. The wound may be probed to determine the degree of undermining and full depth and extent. In particular, determine whether it appears contiguous with tendon or bone or deeper compartments within the foot.

Further complicating the issue is the fact that cutaneous compromise is not a prerequisite for the development of infection. Cellulitis and necrotizing fasciitis are two conditions which do not require a visible portal of entry. Infection may also be spread hematogenously and lead to either a septic joint or osteomyelitis.

IDENTIFYING THE BACTERIA

Every effort should be made to determine which bacteria are likely to be involved with the infectious process. Frequently upon initial presentation one may arrive at the decision based purely upon the clinical presentation and history of the patient. The vast majority of postoperative infections involving clean orthopedic surgery involve *Staphylococcus aureus*. A particular concern today is whether or not the infection was hospital acquired. If so, then one may need to consider the possibility that the *Staph* may be methicillin resistant and prescribe antibiotics accordingly. Nursing home patients will generally have a higher incidence of the methicillin resistant strains. Cellulitis is usually caused by either *Staphylococcus* or *Streptococcus* and only in immunocompromised or debilitated patients are other organisms seen. Children may be another exception where cellulitis due to *Hemophilus* may be found on occasion.

One should also examine the wound and drainage for helpful information. The color of the drainage or purulence will also depend upon the type of infection present. A postoperative wound

infected with *staphylococcus* may have so much hemorrhage that one does not see the classic creamy white to yellow purulence characteristic of this organism. *Pseudomonas* may produce a greenish color or hue which may be detected on the bandage. This organism also may have a characteristic yeasty, sweet odor. Anaerobic bacteria will have an odor which is noteworthy and is learned by experience. This is especially important because many laboratories will fail to recover anaerobes upon culture leaving one to prescribe the appropriate antibiotics based upon clinical findings alone.

Another means of providing good, rapid, appropriate antibiotic coverage is through the use of a gram stain. This will allow the clinician to obtain a basic profile of the bacteria and guide the initial drug therapy. However, the specimen must be taken from a reliable source. Purulence exuding from a postoperative wound is more reliable than a swab of a sinus tract or ulcer. Any open wound will serve as a site of colonization for the normal bacterial flora. Therefore, the gram stain of the bacteria from this type of wound may bear no resemblance to the bacteria actually creating the infection. It is preferable to use the gram stain following a surgical incision and drainage where there is less risk of contamination with other organisms.

Cultures should similarly be taken in a careful manner to ensure that the actual bacteria creating the infection have been recovered. Sinus tract cultures do not consistently reflect the bacteria which are causing infection in the deeper tissues and may prove a source of confusion.

Cultures may be obtained by a variety of means. Generally a surgical swab is reliable, particularly if the ulcer or area of tissue compromise has been avoided with the incisional approach. If osteomyelitis is suspected, then bone biopsies and bone cultures should be performed as this is the most definitive means of diagnosing bone infection.

Aspirates of abscesses are also fairly reliable at recovering bacteria. In some circles, aspiration at the erythematous rim for a patient with cellulitis is advocated. However, it has been shown that this results in a very poor rate of recovery unless some other bacteria besides *Staphylococcus* or *Streptococcus* is involved.

SYSTEMIC SIGNS AND SYMPTOMS

When a patient presents to the office or hospital with a suspected infection one of the first objectives will be to obtain the vital signs. Fever is one of the primary responses to infection and may be constant or intermittent. However, patients with a chronic infection or those who are debilitated may not demonstrate a marked elevation in temperature. Elderly patients may not have as remarkable an increase in the fever as one would suspect with infection. As an infection increases the body's metabolic demand, both the pulse and respiration rates may be elevated as well.

One should also question the patient for symptoms which may be suggestive of a septicemia. In addition to fever the patient may experience chills, rigor, diaphoresis, nausea, diarrhea, and loss of appetite. Chills represent the most significant finding and are representative of bacteria being seeded into the systemic circulation. Chills in this regard do not mean the normal "chilly" sensation which may periodically be experienced with any febrile process, but rather uncontrolled teeth chattering and bed shaking. A chill is generally followed within 90 minutes by a more acute elevation in the temperature.

Palpable, tender popliteal or inguinal lymph nodes may also be indicative of further spread of

the infection. Lymph nodes may be swollen for a variety of reasons, especially in children. However, in infection they are generally tender as well.

The preceding discussion should highlight the clinical approach to the diagnosis of infection and a rational process for evaluation.

RISK MANAGEMENT CONCERNS

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