Actinomycosis : An Update
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Abstract:
Actinomycosis is a very rare disease caused usually by one of a group of opportunistic otherwise harmless commensals that may be complicated by one or more of another group of zoogleans. Because of its rarity, there is a chance of missing its diagnosis & proper treatment leading to substantial morbidity & mortality. Maltreated patients are at risk of developing life-threatening complications. This article is intended to review the present status of aetiology, pathology, clinical features, complications & management of actinomycosis.

Keywords
Actinomyces israeli, Actinomyces gerencseriae, Actinomyces naeslundii, Actinomyces odontolyticus, Actinomyces viscosus, Actinomyces turgidus, Actinomyces meyeri, Propionibacterium propionicus, Peptostreptococcus, Actinobacillus actinomycetemcomitans, Prevotella, Fusobacterium, Bacteroides, Staphylococcus, Streptococcus, Enterobacteriaceae, actinomyces.

Introduction:
Actinomycosis was once a common & ultimately fatal disease1. Now the number has declined since the introduction of antimicrobial agents. The outlook of patients suffering from this infection has improved remarkably. Few physicians see many cases. As patients no longer commonly present advanced disease, actinomycosis has become a more diagnostic challenge2. Actinomycosis is a subacute-to-chronic bacterial infection characterized by contiguous spread, supplicative and granulomatous inflammation, and formation of multiple abscesses and sinus tracts that may discharge ‘sulfur granules’3. As a disease process, the causative organism can primarily or secondarily invade gum, jaw4, neck, pleura, lungs5, liver6, kidney7, appendix8, caecum9, skin, heart10, meninges11 etc. Even bones like mandible, ribs & vertebrae (causing osteomyelitis)12 are not immune to its invasion. The most common clinical forms of actinomycosis are cervicofacial (ie, lumpy jaw), thoracic, and abdominal. In women, pelvic actinomycosis is documented13. Epidural abscesses14, Meningitis15, Endocarditis, Pericarditis16, Pneumonia (Community Acquired17 or Nosocomial18), Lung abscess19, Bronchiectasis20, Empyema Thoracis20 etc when caused by these organisms remain undiagnosed or if not properly treated would endanger the life of the patient. There are significant morbidities as well.

Aetiology
The causative organisms are non-motile, non-sporge forming, non-acid fast, Gram positive pleomorphic, anaerobic-to-microaerophilic filamentous bacterial rods21. The most common ones are: Actinomyces israeli, Actinomyces gerencseriae, Actinomyces naeslundii, Actinomyces odontolyticus, Actinomyces viscosus, Actinomyces turgidus, Actinomyces meyeri, Propionibacterium propionicus. In addition to these microorganisms, almost all actinomycotic lesions contain so-called companion bacteria. The most important of these bacteria is Actinobacillus actinomycetemcomitans, followed by Peptostreptococcus, Prevotella, Fusobacterium, Bacteroides, Staphylococcus, Streptococcus, and Enterobacteriaceae, depending on the location of actinomycotic lesions. These companion bacteria appear to magnify the low pathogenic potential of actinomyces22.

Actinomycosis can affect people of all ages, but the majority of cases are reported in young to middle-aged adults (aged 20-50 yrs). No racial predilection exists. For unknown reasons, men are affected more commonly than women, with the exception of pelvic actinomycosis11. The reported male-to-female ratio is 3:1.

Actinomycosis occurs worldwide, with likely higher prevalence rates in areas with low socioeconomic status and poor dental hygiene.

History
Bollinger first reported the yellow granules in jaw masses of cattle in 1877. In 1878, Israel described the first human case. In 1879, Hartz first observed the microscopic appearance of granules of actinomyces infection.

Frequency
Actinomycosis is a rare infection. Its exact incidence is not known in Bangladesh. During the 1970s, the reported annual incidence in the Cleveland area of the United States was 1 case per 300,00023. Improved dental hygiene and widespread use of antibiotics for various infections probably have contributed to the declining incidence of this disease1.
Pathology

Actinomyces are prominent among the normal flora of the oral cavity but less prominent in the lower gastrointestinal tract and female genital tract. As these microorganisms are not virulent, they require a break in the integrity of the mucous membranes and the presence of devitalized tissue to invade deeper body structures and cause human illness. Furthermore, actinomycosis generally is a polymicrobial infection, with isolates numbering as many as 5-10 bacterial species. Establishment of human infection may require the presence of such companion bacteria, which participate in the production of infection by elaborating a toxin or enzyme or by inhibiting host defenses. These companion bacteria appear to act as pathogens that enhance the relatively low invasiveness of actinomyces. Specifically, they may be responsible for the early manifestations of the infection and for treatment failures. Once infection is established, the host mounts an intense inflammatory response (ie, suppurative, granulomatous), and fibrosis may develop subsequently. Infection typically spreads contiguously, frequently ignoring tissue planes and invading surrounding tissues or organs. Ultimately, the infection produces draining sinus tracts. Hematogenous dissemination to distant organs may occur in any stage of the infection, whereas lymphatic dissemination is unusual.

Cervicofacial actinomycosis

Cervicofacial actinomycosis is the most common manifestation, comprising 50-70% of reported cases. Infection typically occurs following oral surgery or in patients with poor dental hygiene. This form of actinomycosis is characterized in the initial stages by soft-tissue swelling of the perimandibular area. Direct spread into the adjacent tissues occurs over time, along with development of fistulas (sinus tracts) that discharge purulent material containing yellow (ie, sulfur) granules. Invasion of the cranium or the bloodstream may occur if the disease is left untreated.

Thoracic actinomycosis

Thoracic actinomycosis accounts for 15-20% of cases. Aspiration of oropharyngeal secretions containing actinomyces is the usual mechanism of infection. Occasionally, thoracic actinomycosis may result from the introduction of organisms via esophageal perforation, by direct spread from an actinomyotic process of the neck or abdomen, or via hematogenous spread from a distant lesion. Thoracic actinomycosis commonly presents as a pulmonary infiltrate or mass, which, if left untreated, can spread to involve the pleura, pericardium, and chest wall, ultimately leading to the formation of sinuses that discharge sulfur granules.

Actinomycosis of the abdomen and pelvis

Actinomycosis of the abdomen and pelvis accounts for 10-20% of reported cases. Typically, patients have a history of recent or remote bowel surgery (eg, perforated acute appendicitis, perforated colonic diverticulitis following trauma to the abdomen) or ingestion of foreign bodies (eg, chicken or fish bones), during which actinomyces is introduced into the deep tissues. The ileocecal region is involved most frequently, and the disease presents classically as a slowly growing tumor. Diagnosis is usually established postoperatively, following exploratory laparotomy for a suspected malignancy. Involvement of any abdominal organ, including the abdominal wall, can occur by direct spread, with eventual formation of draining sinuses. Actinomycosis of the pelvis most commonly occurs by the ascending route from the uterus in association with intrauterine contraceptive devices (IUCDs). In such cases, an IUCD has been in place for an average of 8 years.

Complications

Osteomyelitis of the mandible, ribs, and vertebrae, CNS disease, including brain abscess, chronic meningitis; actinomycetoma; cranial, epidural, and subdural infection; and spinal epidural infection, Hepatic actinomycosis, Renal actinomycosis, Endocarditis, Pericarditis, Pneumonia (Community Acquired or Nosocomial), Lung abscess, Bronchiectasis, Empyema Thoracis etc. In addition to its serious nature of organ involvement, it can complicate other operations or situations like hip prosthesis infection, septic arthritis, endodontic infection, IUD infection, postoperative viscous endophthalmitis, etc. Opportunistic actinomycotic infection has been reported in osteoradionecrosis in patients having head & neck cancer. Disseminated actinomycosis by Actinomyces meyeri & Actinobacillus actinomycetemcomitans has also been reported.

Clinical Features

1. History taking

For Cervicofacial actinomycosis (ie, lumpy jaw): History of dental manipulation or trauma to the mouth, poor oral hygiene, dental caries, or periodontal disease, local tissue damage caused by neoplasia or radiation treatment, or of painless or occasionally painful soft-tissue swelling involving the submandibular or perimandibular region; over time, multiple sinuses drain pus containing sulfur granules; tendency to remit and recur, or of reddish or bluish discoloration of the skin overlying the lesion or of chewing difficulties (ie, with involvement of mastication muscles)

For Thoracic actinomycosis: History of aspiration (Risk factors include seizure disorder, alcoholism, and poor dental hygiene), or of dry or productive cough, occasionally blood-streaked sputum, shortness of breath, chest pain, or of fever, weight loss, fatigue, anorexia.

For Abdominal actinomycosis: History of abdominal surgery, perforated viscus, mesenteric vascular insufficiency, or ingestion of foreign bodies (eg, fish or...
chicken bones), or of Nonspecific symptoms: The most common nonspecific symptoms are low-grade fever, weight loss, fatigue, or of change in bowel habits, or of vague abdominal discomfort, or of nausea, or of vomiting, or of sensation of a mass.

For Pelvic actinomycosis: History of IUCD, or of lower abdominal discomfort, abnormal vaginal bleeding or discharge.

2. Physical findings:

For Cervico-facial actinomycosis: Tender or nontender woody hard multiple nodular lesions, usually located at the angle of the jaw, multiple abscesses, and multiple sinuses that open onto the cheek or submandibular area, sulfur granules in the exudate, typical absence of lymphadenopathy, with or without trismus & fever.

For Thoracic actinomycosis: Fever, cachexia, abnormal breath sounds, cough (dry or productive of purulent sputum), hemoptysis, sinus tracts with drainage from the chest wall (ie. pleural/bronchocutaneous fistula)

For Abdominal actinomycosis: Scar(s) from antecedent abdominal surgery, low-grade fever and cachexia (variably present), mass most often located in the right lower quadrant, less frequently in the left lower quadrant, mass typically firm to hard in consistency, nontender, often fixed to underlying tissue, sinus tracts with drainage from either the abdominal wall (ie. peritoneocutaneous fistula) or the perianal region

For Pelvic actinomycosis: Pelvic mass, menometrorrhagia, other manifestations, as in abdominal actinomycosis.

Different Diagnoses

Abdominal abscess, Lung cancer, Adnexal tumours, Non-Hodgkin’s Lymphoma, Appendicitis, Small & Large intestinal malignancy, Blastomycosis, Nocardiosis, Brain abscess, Epidural abscess, Pelvic Inflammatory Disease, Aspiration pneumonia, Bacterial pneumonia, Fungal pneumonia, Crohn’s disease, Diverticulitis, Tuberculosis, Lung abscess, Liver abscess, Uterine cancer, Any abdominal mass1,2,20

Laboratory Studies

(A) CBC count: Anemia and mild leukocytosis are common2.

(B) Erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) levels are often elevated3.

(C) Chemistry results usually are normal, with the exception of a frequently elevated alkaline phosphatase level in hepatic actinomycosis30.

(D) Organism cultures31

(a) Because actinomycosis is difficult to diagnose based on the typical clinical features, direct identification and/or isolation of the infecting organism from a clinical specimen or from sulfur granules is necessary for definitive diagnosis in most cases.

a. Acceptable specimen material is obtained from draining sinuses, deep needle aspirate, or biopsy specimens, swabs, sputum, and urine specimens are unacceptable or inappropriate.

b. Prompt transport of the specimens to the microbiology laboratory is necessary for optimal isolation of actinomycetes, preferably in an anaerobic transport device.

c. A Gram-stained smear of the specimen may demonstrate the presence of beaded, branched, gram-positive filamentous rods, suggesting the diagnosis of actinomycosis.

d. Cultures should be placed immediately under anaerobic conditions and incubated for 48 hours or longer, the isolation and definitive identification of actinomycetes may require 2-3 weeks.

e. Nucleic acid probes and polymerase chain reaction (PCR) methods are being developed for more rapid and more accurate identification.

f. Antimicrobial susceptibility testing is not indicated in the management of actinomycosis, partly because of their predictable antibiogram.

(b) The preliminary diagnosis of actinomycosis also can be made by examining sulfur granules30. Granules should be crushed between 2 slides, stained with 1% methylene-blue solution, and examined microscopically for features characteristic of actinomycetes.

(c) Serologic diagnosis: Current serologic tests have no role in diagnosing actinomycosis.

Papanicolaou test31,17:

a. The relationship between a Papanicolaou test that is positive for actinomyocetlike organisms and the eventual development of pelvic actinomycosis is unclear.

b. The prevalence of smears positive for Actinomyces organisms in women who use IUCDs is approximately 7%.5

c. Because of the lack of sensitivity and specificity and lower positive predictive value, the prognostic significance of detecting Actinomyces organisms is minimal in the absence of concomitant symptoms.

Imaging Studies: Chest X-ray & CT Scan

A chest radiograph30 may reveal a poorly defined mass or pneumonitis or cavitatory lesion, with or without pleural involvement. Hilar adenopathy is uncommon. The presence of a masslike lesion that extends across fissures or pleura, invades into the adjacent chest wall or thoracic vertebrae, or causes local destruction of the ribs or sternum suggests thoracic actinomycosis.
CT scanning\(^{22}\) (irrespective of the anatomic area of involvement) usually reveals an infiltrative mass with focal areas of decreased attenuation that enhance with contrast. This infiltrative mass tends to invade surrounding tissues. Surrounding lymphadenopathy is uncommon.

Sometimes Colonoscopy, CT scans are combined required for diagnosis\(^3\).

**FNAC & Open biopsy**

CT scan or ultrasound-guided fine-needle aspiration and/or biopsy\(^3,20,22\) have been used successfully to obtain clinical material for diagnosis of actinomycosis.

Surgery\(^24\) (e.g., thoracotomy with open lung biopsy, exploratory laparotomy) may be required for diagnostic purposes.

**Histologic Findings**

Actinomycosis is characterized by mixed supplicative and granulomatous inflammatory reactions, connective-tissue proliferation, and the presence of sulfur granules\(^2,20\).

![Fig. A- Actinomycosis in Endometrial tissue](image)

The sulfur granules are nearly pathognomonic for actinomycosis, although similar findings have been reported with infections caused by Nocardia brasiliensis, Streptomyces aureus, and Staphylococcus aureus presenting as botryomycosis. The granules are approximately 0.1-1 mm in diameter and may be seen with the naked eye as yellowish particles.

Microscopically, the granules manifest a cauliflower-like shape at low magnification; at higher magnification (X100), when the particle has been pressed between slide and coverslip, a clump of filamentous actinomycete microcolonies surrounded by polymorphonuclear neutrophils (PMNs) can be observed. Gram stain reveals these microcolonies visible as gram-positive, intertwined branching filaments, with radially arranged, peripheral hyphae. Coexisting with them are the companion bacteria, which are gram-positive and gram-negative cocci and rods.

**Treatment**

**Medical treatment:**

In most cases of actinomycosis, antimicrobial therapy\(^1,22,20\) is the only treatment required, although surgery can be adjunctive in selected cases. Penicillin G is the drug of choice for treating infections caused by actinomycetes.

High-dose penicillin (Adult: Penicillin G 12-24 million U/d IV by continuous infusion or in divided doses q12h for 1-2 wk, then switch to PO (penicillin VK) for 6-12 mo] administered over a prolonged period (6 months to 1 year) is the cornerstone of therapy for actinomycosis. Success with shorter courses of therapy (<6 mo) has been reported, especially in cervicofacial actinomycosis. Ultimately, the treatment duration should be tailored to the individual patient based on clinical and radiographic response. Patients should be monitored more closely if shorter treatment durations are considered.

The risk of actinomycetes developing penicillin resistance appears to be minimal. Lack of a clinical response to penicillin usually indicates the presence of resistant companion bacteria, which may require modification of the antibiotic regimen (i.e., addition of an agent that is active against these pathogens).

Alternative to Penicillin if the patient is hypersensitive to penicillin or the causative organisms are resistant to Penicillin are Ceftriaxone (Adult: 2 g IV/IM q12-24h; not to exceed 4 g/d), Imipenem/Cilastatin (Adult: 500 mg-1000 mg IV q6h; to not exceed 4 g/d), Clindamycin (Adult: 600 mg IV q6h, or 150-300 mg PO q6h), Amoxicillin/Clavulanic acid (Adult: 500 mg PO q6h, or 875 mg PO q12h), Doxycycline (Adult: 100 mg PO/IV q12h), Tetracycline, Lincomycin, Macrolides (erythromycin, Carbomycin, Spiramycin, Oleandomycin) – all these are effective. But the sensitivity should be checked in the laboratory\(^3\). Recalcitrant actinomycosis sometimes need treatment with ciprofloxacin\(^22\). Antibiotics that possess no activity against Actinomyces specie include metronidazole, aminoglycosides, aztreonam, co-trimoxazole (TMP-SMX), penicillinase-resistant penicillins (e.g., methicillin, nafcillin, oxacillin, cloxacillin), and cephalaxin. The data concerning the fluoroquinolones (ciprofloxacin, levofloxacin, moxiﬂoxacin) are limited, however, treatment success has been cited in case reports.

**Surgical treatment:**

Attempts are made to cure actinomycosis, including extensive disease, with aggressive antimicrobial therapy alone initially. Surgery is indicated to take a biopsy specimen, to drain abscesses, to excise (wide excision) a fibrotic sinus tract (not responsive to conservative treatment) or a calcified fistula tract, to decompres or remove a intra-cranial or intraspinal Space Occupying Lesion, to remove severely damaged segment of lung or liver, relieving obstruction (eg, when actinomycotic lesions compress the ureter)\(^20\), & to repair a defect, or to rule out a Bronchogenic carcinoma etc\(^24\).

Probenecid can increase effects; coadministration of tetracyclines can decrease effects.

**Follow up**

Follow up should be adequate & meticulous to have a complete cure of the disease\(^2,20\).
Prophylaxis:

Maintenance of good oral hygiene and adequate regular dental care are important. Patients and physicians alike should be aware of the increased risk of infection associated with insertion of IUCD.11,16,30

Prognosis

The availability of antibiotics has greatly improved the prognosis for all forms of actinomycosis.1 At present, cure rates are high and neither deformity nor death is common. When actinomycosis is diagnosed early and treated with appropriate antibiotic therapy, the prognosis is excellent. The more advanced and complicated actinomycotic forms require aggressive antibiotic and surgical therapy for optimal outcome; however, deaths can occur despite such therapy.25,26

Conclusion:

As it is an endogenous disease, there is no risk of person to person transmission. This is an important message for health personnel & patient attendants and relatives. To minimize delays in diagnosis, actinomycosis should be considered in the differential diagnosis of any inflammatory lesion of subacute or long-term nature.

References: