

Actinomyces Characteristics of Hematological and Foreign Body Infections

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Received date: October 01, 2021; Accepted date: October 15, 2021; Published date: October 22, 2021

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Abstract

Actinomycosis is a rare indolent infection caused by the gram-positive anaerobic to microaerophilic bacteria, *Actinomyces*. Usually found in the oropharynx, gastrointestinal and urogenital tracts as commensal flora, oral-cervicofacial manifestations are the most common, yet disruption of the mucosa may lead to infection in any site via hematogenous spread, including foreign body infections. This mini review article will highlight the characteristics of *Actinomyces* in terms of bacteremia, endocarditis and foreign body infection.

Keywords *Actinomyces*; Actinomycosis; *Actinomyces* foreign body infection; *Actinomyces* endocarditis; *Actinomyces* bacteremia

Introduction

Actinomyces is a genus of gram-positive, filamentous bacteria, most species are anaerobes; a few are microaerophilic. It is a human commensal organism of the oral, gastrointestinal, and pelvic mucosa. *Actinomycosis* is an indolent infection caused by *Actinomyces* and closely related species. Characteristics include chronicity, crossing of tissue boundaries, and mass like features. Treatment involves a high dose and prolonged course of antibiotics, often with Penicillin G. Refractory or relapsing infection may occur after a short course of therapy. Infections caused by this organism are rare but may occur, more commonly in immune compromised patients. Although the most common manifestation of the disease is cervicofacial, genitourinary, and abdominal, it can also spread hematogenously and cause infection in virtually any site. More rarely, it causes endocarditis, and foreign body infections, as aspirated, ingested, or implanted foreign bodies may contribute to pathogenesis via facilitating the growth, survival, and biofilm formation [1].

Actinomyces Bacteremia

Bacteremia from *Actinomyces* is rare, most commonly transient, occurring after dental procedures. The isolation of *Actinomyces* from sterile clinical samples is traditionally regarded as significant, yet questionable in patients for whom there is no evidence of clinical disease, raising the question of whether these organisms are blood culture contaminants or represent transitory *bacteremia* caused by translocation from commensal sites. Such *bacteremia*, although transient, can cause significant morbidity through the sepsis response and seeding [2]. Although uncommon, all the agents of *actinomycosis* are capable of hematogenous dissemination resulting in multi organ involvement. Disease in any location may serve as the source for spread. The lungs and liver are the most commonly affected organs, and the presentation of multiple nodules mimics disseminated malignancy. The kidneys, brain, spleen, skin, soft tissues of the extremities, and, less commonly, the heart valves may also be infected in various combinations. The clinical presentation may be surprisingly indolent when the extent of disease is appreciated [1].

Actinomyces Endocarditis

Infective endocarditis caused by *Actinomyces* species is rare with only 33 reported cases since 1939. To date, 15 species of *Actinomyces* have been implicated in endocarditis: *Actinomyces bovis*, *Actinomyces graminis*, *Actinomyces septicus*, *Actinomyces muris*, *Actinomyces oris*, *Actinomyces israelii*, *Actinomyces viscosus*, *Actinomyces meyeri*, *Actinomyces pyogenes*, *Actinomyces funkei*, *Actinomyces odontolyticus*, *Actinomyces neuii*, *Actinomyces georgiae*, *Actinomyces turicensis*, and *Actinomyces naeslundii* [3]. Of the 33 reported cases of infective endocarditis caused by *Actinomyces* species, only one case was associated with a foreign body infection other than prosthetic valve, which was an implantable cardioverter defibrillator related endocarditis (ICD) [4]. In these 33 cases, the median age was 48 years (13-81 years), mostly males (70%), seventeen patients (52%) had underlying cardiac disease, eight patients (24.2%) had a history of recent dental procedure or presence of dental caries, 29 cases (87.87%) involved a native valve, nine patients (27.2%) required cardiac surgery. The overall mortality associated with *actinomycotic* endocarditis was 24.2% (8 of 33 patients) [3-5]. Predisposing factors for *actinomycotic* endocarditis include periodontal diseases or dental procedures in association with a pre-existing cardiac valvular defect [3], right-sided valvular involvement is associated with intravenous drug use, when *Actinomyces* is introduced through oral flora [6]. Although six reported cases occurred with the absence of predisposing conditions. A case of an implantable cardioverter defibrillator associated endocarditis and bacteremia, described a patient with no valvular or periodontal disease, with an infection introduced to the native valve through a contaminated foreign body at the time of insertion, source control by removing the infection device in addition to prolonged treatment with high dose penicillin, lead to resolution of the disease [4]. The diagnosis of *actinomycotic* endocarditis primarily depends on the identification of *Actinomyces* species from blood cultures. The choice and optimal duration of antibiotics in *actinomycotic* endocarditis remains unclear, Penicillin have been considered to be first-line agents for the treatment of *actinomycosis*, according to previous reports, most patients with endocarditis tended to receive high doses and prolonged antibiotic therapy mostly with Penicillin, although some were treated with other antibiotics such as ceftriaxone and ceftizoxime, that have shown anecdotal successes in clinical

experience, and vancomycin which was shown to be active against actinomyces in in-vitro studies (Table 1) [1].

Clinical Characteristics	N (%)
Age, years, (range)	48 (13-81)
Sex (male)	23 (70)
Underlying cardiac disease	17 (52)
History of recent dental procedures or presence of dental caries	8 (24.2)
Native valve	29 (87.87)
Mitral valve	11 (33.3)
Aortic valve	7 (21.21)
Mitral and aortic valve	6 (18.18)
Eustachian valve	2 (6.5)
Prosthetic valve	4 (12.12)
ICD	1 (3.03)
Treatment with non-β-lactams antibiotics	7 (21.21)
Required surgery	9 (27.2)
Duration of treatment (months) (range)	1-12
Death	8 (24.2)

Table 1: Clinical characteristics, treatment, and outcome of endocarditis cases caused by *actinomyces* species.

Actinomyces Foreign Body Infections

Foreign bodies appear to facilitate growth and infection, also through biofilm formation. This association has been most commonly observed with Intra-Uterine Contraceptive Devices (IUCD) pelvic actinomycosis and less commonly with thoracic disease and aspirated foreign bodies (such as fish bones) [1]. Associations with *actinomycosis* and foreign material elsewhere are less strong, yet existent. We systematically searched the English-language literature using PubMed as well as secondary sources for case reports pertaining to *Actinomyces* related prosthetic device infections, using the search terms “*Actinomyces* prosthesis”, “*Actinomyces* prosthetic”, “*Actinomyces* hip”, “*Actinomyces* knee”, “*Actinomyces* arthroplasty”, “*Actinomyces* joint”, “*Actinomyces* prosthesis”, “*Actinomyces* foreign body”, “*Actinomyces* implant”, “*Actinomyces* device”, “*Actinomyces* catheter” and “*Actinomyces* silicone. We found multiple reports describing Actinomycotic disease linked to variable foreign body infections, occurring in different locations. Including one case of a silicone tissue expander [7], one case of a mammary prosthesis [8], twenty three cases of hip prosthesis [9-21], one case of a dialysis catheter [22], four cases of prosthetic heart valves [3], one case of a penile prosthesis [23], two cases of ventriculoperitoneal shunts [24,25], one case of an implantable cardioverted defibrillator[4], one case of a coronary artery stent [6], one case of a shoulder prosthesis [26], eight cases of knee prosthesis [9,27,28], and a case of trans-obturator sling [29]. Species described in these infections included *Actinomyces Neuui*, *Actinomyces*

Naeslundii, *Actinomyces Odontolyticus*, *Actinomyces oris*, *Actinomyces Gerencseriae*, *Actinomyces Israelii*, *Actinomyces Viscosus*, *Actinomyces Europaeus*, and *Actinomyces Radingae*. Removal of prosthetic devices and prolonged antibiotic treatment led to favorable outcomes in most of the cases.

In cases of prosthetic joint infections, joints can become infected *via* local trauma (since *Actinomyces* spp. are found in the soil) and hematogenously from endogenous sources, more causes include dental related conditions [17], presence of IUD device associated with pelvic actinomycosis [11], prior prosthesis infection, peri-surgical infection due to contamination and hematogenous spread from the patient’s own bacterial flora [14]. It is well-known that *Actinomyces* species are part of oral flora, thus clinicians should be aware of this association in patients who have foreign bodies implanted and a dental procedure, or periodontal diseases, as it can cause hematogenous seeding to prosthetic devices through mucosal damage. Prosthetic joint infections can be classified into early, delayed, and late onset. Whereas early and delayed infections are thought to have been acquired during surgery, late prosthetic joint infections occur due to hematogenous seeding. E.F observed that *Actinomyces* prosthetic joint infections presented as a late complication of joint replacement surgery. The late onset presentation may reflect its nature of being an organism of low virulence. Joint drainage and sinus tract was frequently encountered in the literature most probably due to *Actinomyces* being an indolent pathogen; this led to radiologic manifestations such as periprosthetic loosening or lucency [9]. From our review of the literature, we found that the majority of *actinomycosis* foreign body infections cases reported were hip prosthesis infections.

Although these reports are not considered significant in number and these infections are still rather rare, we have observed an increase in the reported cases recently and their variability, which further illustrates this infection’s capability in causing infection in a wide range of foreign bodies, other than what is commonly known with intrauterine devices and dental implants. This fact should be taken into consideration in patients with a foreign body, who present with *Actinomyces bacteremia*, fever and a history of a recent dental procedure, and in patients who present signs of prosthesis infection or fever and *bacteremia*, with a recent foreign body insertion presenting as an indolent disease, as it can determine the empirical antibiotic treatment prior to organism identification.

Discussion

Actinomycosis is a rare indolent disease, with a favorable prognosis if detected and treated early. Hematological spread can occur mainly due to breaches in mucosal continuity in locations where it is found as commensal flora, increasing the risk of a disseminated disease, including endocarditis and foreign body infections.

Foreign body infections are usually attributed to intra uterine contraceptive devices, association with *actinomycosis* and foreign material elsewhere are less strong. In our literature review, we have observed that this organism is capable of infecting foreign bodies of variable kinds, facilitating infection through biofilm formation, this fact is particularly crucial in patients who have a valvular defect, are immune compromised, or have a foreign body of any type, as they are predisposed to developing such infection. The basis of management includes clinical examination, high index of suspicion, histopathology, isolation, and culture of organism. Genitourinary and colonic colonization of *Actinomyces* spp. should also be appreciated,

including presence of IUD. If history and physical exam is suggestive of an abdominal source, a CT scan of abdomen and pelvis to characterize the origin of infection is reasonable. Treatment includes probing for the source of the infection, infected foreign body removal, and antibiotic treatment. Drug of choice is Penicillin G. High-dose Penicillin G-12-24 million U/d administered intravenously, followed by oral amoxicillin, ampicillin, or penicillin V which is administered over a prolonged period (6 months to 1 year) [11]. Further research to look more closely at *Actinomyces* relation to endocarditis and foreign body infections is needed to elucidate the management in people with a high risk and predisposing conditions.

Conclusion

This mini review highlights the importance of recognizing a rare yet clinically significant feature of *Actinomyces* in probing for the source of infection in endocarditis and foreign body infections, which is a critical part of treatment, improving outcomes of recovery and lowering the risk of recurrence.

References

- Russo TA (2014) Agents of *Actinomycosis*. in Mand Douglas, Bennett's Princ Pract Infect Dis pp: 2864-2873.e3.
- Jeffery-Smith A, Nic-Fhogartaigh C, Millar M (2016) Is the presence of *actinomyces* spp. in blood culture always significant? J Clin Microbiol 54:1137-1139.
- Phichaphop C, Apiwattanakul N, Wanitkun S, Boonsathorn S (2020) Bacterial endocarditis caused by *actinomyces* oris: First reported case and literature review. J Inv Med High Impact Case Rep 8.
- Farah Khoury M, Perek S, Raz-Pasteur A (2021) Implantable cardioverter defibrillator related *Actinomyces Odontolyticus* endocarditis and *bacteremia*-first reported case. IDCases 25:4-6.
- Patel K, MacDonald M, Hmoud H, Czinn E, Wutawunashie C, et al. (2021) Aortic valve *endocarditis* by *Actinomyces* odontolyticus and *Gemella morbillorum* oral pathogens. IDCases 24: e01079.
- Saeed W, Adam M, Abdallah TA, Omrani AS (2020) Percutaneous coronary intervention-associated *Actinomyces* oris. IDCases. 22:e00929.
- Menderes A, Aydin OE, Vayvada H, Baytekin C (2006) Aerobic *Actinomyces* spp. Infection within a silicone tissue expander. J Plastic Recon & Aes Surg 59:560-561.
- Brunner S, Graf S, Riegel P, Altwegg M (2000) Catalase-negative *Actinomyces* neuii subsp. neuii isolated from an infected mammary prosthesis. International J Med Microbiol 290:285-287.
- Dagher R, Riaz T, Tande AJ, Osmon DR, Jagtiani A (2019) Prosthetic Joint Infection due to *Actinomyces* species: A case series and review of literature. J Bone Joint Inf 4:174-180.
- Feiran Wu, Nicholas A, Ismaeel A, Masterson E (2011) Infection of a total hip arthroplasty with *actinomyces israelii* Report of a case. North American J Med Sci.
- Sharma S, Sharma SC (2016) Forgotten intrauterine contraceptive device-A threat to total hip prosthesis: A case report with review of the literature. J of Clin Orthopaedics and Trauma 7:130-133.
- Brown ML, Drinkwater CJ (2012) Hematogenous infection of total hip arthroplasty with *Actinomyces* following a noninvasive dental procedure. Orthop 35:1086-1089.
- Björn Petrini TW (1978) Late infection with *actinomyces israelii* after total hip replacement. Scandinavian J Infect Dis 10:313-314.
- Wüst J, Steiger U, Vuong H, Zbinden R (2000) Infection of a hip prosthesis by *Actinomyces naeslundii*. J ClinMicrobiol 38:929-930.
- Brown ML, Drinkwater CJ (2012) hematogenous infection of total hip arthroplasty with *actinomyces* following a noninvasive dental procedure. Orthoped 35:7.
- Strazzeri JC (1986) Infected total hip arthroplasty due to *actinomyces israelii* after dental extraction. A case report. Clin Orthopaed and Rel Res 210:128-31.
- Dubourg G, Delord M, Gouriet F, Fournier PE, Drancourt M (2015) *Actinomyces gerencseriae* hip prosthesis infection: A case report. J Med Case Rep.
- Wu F (2011) Infection of a total hip arthroplasty with *actinomyces israelii*: Report of a case. North American J of Med Sci 3.
- Zaman R, Abbas M, Burd E (2002) Late prosthetic hip joint infection with *actinomyces israelii* in an intravenous drug user: Case report and literature review. J Clin Microbiol 40:4391-4392.
- Redmond SN, Helms R, Pensiero A (2020) A case of actinomyces prosthetic hip infection. Cureus 12: 4-8.
- Rieber H, Schwarz R, Krämer O, Cordier W, Frommelt L (2009) *Actinomyces* neuii subsp. neuii associated with periprosthetic infection in total hip arthroplasty as causative agent. J Clin Microbiol 47:4183-4184.
- Ng TJ, Thiam C, Lim S, Goh BL (2020) *Actinomyces* odontolyticus catheter related bloodstream infection in a hemodialysis patient-First Reported Case 6-8.
- Ryan S Hsi, Hotaling JM, Spencer ES, Bollyky PL (2011) Isolated infection of a decommissioned penile prosthesis reservoir with *actinomyces* neuii. J Sexual Med 8.
- Watkins RR, Anthony K, Schroder S, Hall GS (2008) Ventriculoperitoneal shunt infection caused by *actinomyces* neuii subsp. neuii. J Clin Microbiol 46:1888-1889.
- Anderson IA, Jarral F, Sethi K, Chumas, PD (2014) Paediatric ventriculoperitoneal shunt infection caused by *Actinomyces*. BMJ Case Rep.
- Chen BC, Kobayashi T, Ford B, Sekar P (2020) Late prosthetic shoulder joint infection due to *Actinomyces* in an adult man. BMJ Case Rep 13:e236350.
- Hedke J, Skripitz R, Ellenrieder M, Frickmann H, Koller T, et al. (2012) Low-grade infection after a total knee arthroplasty caused by *Actinomyces naeslundii*. J Med Microbiol 61:162-164.
- Ruhe J, Holding K (2019) Infected total knee arthroplasty due to *Actinomyces naeslundii*. Scandinavian J Infect Dis 33:230-231.
- Özel B, Kuo J (2009) *Actinomyces* infection associated with the transobturator sling. Int Urogynecology J 21.