Actinomycotic Endocarditis of the Eustachian Valve:

A Rare Case and a Review of the Literature

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Eustachian valve endocarditis caused by Actinomyces species is extremely rare. A literature review revealed only one reported case—caused by Actinomyces israelii in an intra-venous drug abuser.

Our patient, a 30-year-old woman who at first appeared to be in good health, presented with fever, a large mobile mass on the eustachian valve, and extensive intra-abdominal and pelvic masses that looked malignant. Histopathologic examination of tissue found in association with an intrauterine contraceptive device revealed filamentous, branching microorganisms consistent with Actinomyces turicensis. This patient was treated successfully with antibiotic agents.

*In addition to presenting a new case of a rare condition, we discuss cardiac actinomy-
cotic infections in general and eustachian valve endocarditis in particular: its predisposing
factors, clinical course, sequelae, and our approaches to its management. (Tex Heart Inst
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Actinomyces species are anaerobic-to-microaerophilic bacteria that survive as normal flora within the mouth, bronchi, gastrointestinal tract, and female genital tract. These organisms are rarely associated with chronic pyogenic or granulomatous infections in the general population.¹ Actinomycotic infections are generally limited to the cervicofacial (50%), pulmonary (15%), and intra-abdominal (20%) areas. Cardiac involvement is relatively rare; most infections occur by contiguous metastasis to the pericardium and very rarely by hematogenous metastasis to the cardiac valves.² Infection of the eustachian valve (EV) by *Actinomyces* species is extremely rare, having (to our knowledge) been reported only once before.³ We report a case of EV endocarditis caused by *Actinomyces turicensis* in an apparently healthy young woman, possibly transmitted by an intrauterine contraceptive device (IUD). In our accompanying review of the relevant literature, we discuss the predisposing factors, the clinical course, and the treatment of various actinomycotic and EV endocarditis.

Case Report

In September 2011, a 30-year-old woman was admitted with right upper quadrant pain and swelling of one week's duration. Her medical history included no recent dental work, no human immunodeficiency viral infection, and no history of intravenous drug use. She had undergone a cesarean section 2 years before presentation, after which an IUD had been placed. Physical examination at admission revealed a firm mass, slightly painful to the touch, in the right upper quadrant. Laboratory results showed marked leukocytosis. A transvaginal ultrasonogram and a computed tomogram revealed multiple large masses in the ovaries, pelvis, and liver that were suspect for extensive metastatic disease, presumably ovarian in origin. Histopathologic studies of tubo-ovarian (Fig. 1A) and liver (Fig. 1B) biopsy samples failed to reveal any malignant cells. Instead, they showed microabscesses with branching filamentous microorganisms consistent with *Actinomyces* species. The patient subsequently underwent an exploratory laparotomy, which revealed multiple pockets of pus with extensive inflammatory changes and fibrinous adhesions. Evacuation of pus was performed, along with total abdominal hysterectomy, right salpingo-oophorectomy, appendectomy, and lysis of adhesions. Cultures of fluid from both the abdominal cavity and the IUD grew *A. turicensis*. Multiple sets of blood cultures performed on the day of

Fig. 1 **A)** Photomicrograph of tubo-ovarian section shows colonies of *Actinomyces* with a branching filamentous appearance (H & E, orig. $\times 200$). **B)** Photomicrograph of liver biopsy specimen shows branching filamentous bacteria, surrounded by liver parenchyma (Grocott-Gomori methenamine-silver stain, orig. $\times 400$). **C)** Computed tomogram performed with intravenous and oral contrast medium reveals a large abscess of the liver (arrow) eroding into the anterior abdominal wall.

admission and during the patient's hospital course failed to reveal any growth of microorganisms.

In view of the extensive actinomycotic infection and consequent risk of abdominal-wall fistula formation, we started her on broad-spectrum antibiotics, including penicillin G, ceftriaxone, and metronidazole. De-

Fig. 2 Transthoracic echocardiograms. **A)** The apical 4-chamber view reveals a mobile, multilobulated vegetation (arrow) attached to the mid portion of a complete Eustachian valve. **B)** The parasternal short-axis view reveals a mobile vegetation (arrow) attached to the Eustachian valve. **C)** After 3 weeks of antibiotic therapy, the apical 4-chamber view reveals complete resolution of the vegetation.

spite the abdominal surgery and antibiotic therapy, the patient continued to be febrile and hypotensive over the next few days. A 2nd computed tomogram of the abdomen showed a right hepatic lobe abscess, which eroded the anterior abdominal wall and extended into the subcutaneous fat of the epigastrium (Fig. 1C). A

TABLE I. Reports of Eustachian Valve Endocarditis

Reference	Structure	Predisposing Factor	Organism	Diagnosis	Therapy	Sequelae
Edwards AD, et al. ⁴ (1986)	EV	Pneumonia	<i>Staphylococcus aureus</i>	Autopsy	Medical	Death
Vilacosta I, et al. ⁵ (1990)	EV	IVDU	<i>S. aureus</i>	TTE	Medical	None
Navarro V, et al. ⁶ (1996)	EV	IVDU	<i>Staphylococcus hominis</i>	TTE	Medical	None
Georgeson R, et al. ⁷ (1996)	EV	IVDU	<i>S. aureus</i>	TEE	Medical	Emboli
Palakodeti V, et al. ⁸ (1997)	EV	IVDU	<i>S. aureus</i>	TEE	Medical	None
Punzo F, et al. ⁹ (1999)	EV	Rheumatic MV and atrial fibrillation	None	TEE	Medical	None
James PR, et al. ¹⁰ (1999)	EV	Pacemaker and hernia repair	<i>Enterobacter cloacae</i>	TEE	Medical	None
Bowers J, et al. ¹¹ (2001)	EV, TV, and severe TR	IVDU	<i>S. aureus</i>	TEE	Surgical	Emboli
Schmidt MA, et al. ¹² (2001)	EV	Poor dentition	<i>Streptococcus viridans</i>	TEE	Medical	Emboli
San Román JA, et al. ¹³ (2001)	EV, TV, and MV	IVDU	<i>S. aureus</i>	TTE	Medical	Emboli
	EV and TV	IVDU	<i>S. aureus</i>	TTE	Medical	Emboli
	EV, TV, PV, and MV	Central line	<i>S. aureus</i>	TTE	Medical	Emboli
	EV, TV, and central line	Central line	<i>S. aureus</i>	TTE	Medical	Emboli
	EV	IVDU	<i>S. aureus</i>	TTE	Medical	Emboli
Sawhney N, et al. ¹⁴ (2001)	EV	IVDU	<i>S. aureus</i>	TEE	Medical	Emboli
	EV	IVDU	<i>S. aureus</i>	TEE	Medical	Emboli
	EV	Central line	<i>Escherichia coli</i>	TEE	Medical	None
	EV and MV	Central line	<i>Proteus vulgaris</i>	TEE	Medical	Death
Pellicelli AM, et al. ¹⁵ (2005)	EV and TV	IVDU	<i>S. aureus</i>	TTE	Medical	None
Wong RC, et al. ¹⁶ (2006)	EV	Acute cholecystitis	<i>Klebsiella pneumoniae</i>	TEE	Medical	None
Skubas N, et al. ¹⁷ (2006)	EV, TV, and moderate TR	ESRD	NA	TEE	Surgical	None
Gill DS, et al. ¹⁸ (2006)	EV	NA	<i>S. aureus</i>	TEE	Medical	None
Veiga VC, et al. ¹⁹ (2007)	EV	Central line	<i>K. pneumoniae</i>	TEE	Medical	None
Jagernauth S, et al. ²⁰ (2007)	EV	Central line, carcinoid of TV, and PV	<i>Candida albicans</i>	TEE	Surgical	None
Kennedy JL, et al. ³ (2008)	EV	IVDU	<i>Actinomyces israelii</i>	TTE	Surgical	Emboli
Deluca G, et al. ²¹ (2008)	EV	Central line	Nonbacterial	TTE	Surgical	None
Lopes A, et al. ²² (2008)	EV	IVDU	<i>S. aureus</i>	TTE	Medical	None
Andrés AS and Moreno JI ²³ (2009)	EV and TV	Preterm	<i>S. aureus</i>	TTE	Medical and surgical	None
Venkatram M, et al. ²⁴ (2009)	EV	AICD	<i>S. aureus</i>	TEE	Medical	None
Current case	EV	Intrauterine device	<i>Actinomyces turicensis</i>	TEE	Medical	None

AICD = automatic implantable cardioverter-defibrillator; ESRD = end-stage renal disease; EV = eustachian valve; IVDU = intravenous drug use; MV = mitral valve; NA = not available; PV = pulmonic valve; TEE = transesophageal echocardiography; TTE = transthoracic echocardiography; TR = tricuspid regurgitation; TV = tricuspid valve

TABLE II. Reports of Actinomycotic Endocarditis

Reference	Structure	Predisposing Factor	Organism	Diagnosis	Therapy	Sequelae
Uhr N ²⁷ (1939)	AV and MV	None	<i>Actinomyces bovis</i>	NA	Medical	CNS emboli, CHF, and death
Beamer PR, et al. ²⁸ (1945)	AV and MV	None	<i>Actinomyces</i> sp.	NA	None	CNS emboli, CHF, and death
MacNeal WJ, et al. ²⁹ (1946)	MV	NA	<i>Actinomyces</i> sp.	NA	Medical	CNS emboli
Wedding ES ³⁰ (1947)	MV	None	<i>Actinomyces</i> sp.	NA	Medical	CHF, emboli, and death
	AV and MV	RHD	<i>Actinomyces</i> sp.	NA	None	Renal failure and death
Walters EW, et al. ³¹ (1962)	AV and MV	RHD	<i>A. bovis</i>	NA	Medical	Emboli
Dutton WP and Inclan AP ³² (1968)	MV	None	<i>Actinomyces israelii</i>	NA	Medical	CHF and death
Gutschik E ³³ (1976)	MV	None	<i>Actinomyces viscosus</i>	NA	Medical	Emboli and CHF
O'Sullivan RA, et al. ³⁴ (1991)	MV and pericardial disease	Smoking, alcoholism, and diabetes mellitus	<i>Actinomyces meyeri</i> and <i>Actinobacillus</i> sp.	Cultures of foot abscess and lung tissue	NA	Antibiotics and thoracotomy with partial pericardiectomy
Lam S, et al. ³⁵ (1993)	AV and MV	RHD	<i>A. israelii</i>	NA	Medical	None
Moffatt S, et al. ³⁶ (1996)	AV	Chronic rheumatic arthritis	<i>A. meyeri</i>	Blood culture and TTE	Medical	None
Reddy I, et al. ³⁷ (1997)	AV	Aortic stenosis	<i>Actinomyces pyogenes</i>	NA	Medical and surgical	Emboli and CHF
Hamed KA ³⁸ (1998)	AV	None	<i>A. viscosus</i>	NA	Medical	None
Huang KL, et al. ³⁹ (1998)	MV	None	<i>A. meyeri</i>	NA	Medical	None
Mardis JS, et al. ⁴⁰ (2001)	MV	Dental cleaning	<i>A. viscosus</i>	TEE	Medical	None
Westling K, et al. ⁴¹ (2002)	TV	IVDU	<i>Actinomyces funkei</i>	NA	Medical	NA
Julian KG, et al. ⁴² (2005)	AV	Recent dental cleaning	<i>A. viscosus</i>	AV tissue culture and TEE	Medical and surgical	CHF
Oh S, et al. ⁴³ (2005)	TV	IVDU	<i>Actinomyces odontolyticus</i> and <i>Veillonella</i>	Blood culture and TEE	Medical	None
Oddó BD, et al. ⁴⁴ (2007)	MV	Chronic rheumatic disease	<i>Actinomyces</i> sp.	NA	NA	NA
Grundmann S, et al. ⁴⁵ (2009)	Prosthetic AV	AV replacement and implantation of conduit because of thoracic aortic aneurysm and AV insufficiency	<i>Actinomyces neuui</i>	Blood culture and TEE	Medical	None

AV = aortic valve; CHF = congestive heart failure; CNS = central nervous system; IVDU = intravenous drug use; MV = mitral valve; NA = not available; RHD = rheumatic heart disease; TEE = transesophageal echocardiography; TTE = transthoracic echocardiography; TV = tricuspid valve

transthoracic echocardiogram (TTE), performed for the evaluation of any cardiac cause of hypotension, showed a 2.7 × 2-cm mobile and multilobulated echogenic mass attached to a congenitally complete EV in the right atrium. This mass was consistent with a large EV vegetation, probably the product of hematogenous actinomycotic seeding from the liver abscess (Figs. 2A–B). The tricuspid valve was free of any vegetation and displayed minimal tricuspid regurgitation. The patient underwent surgical drainage of the liver abscess, and the course of antimicrobial therapy was continued.

Postoperatively, she showed gradual clinical improvement, along with resolution of her fever and leukocytosis. In order to reevaluate the extent of cardiac involvement, we repeated TTE on day 20 after the patient's initial presentation, and this showed near-complete resolution of the vegetation (Fig. 2C). After a month-long hospital course on the previously mentioned antibiotic agents, the patient was discharged from the hospital on penicillin G and imipenem. She received these 2 agents for an additional 30 days, which concluded 8 weeks of therapy in total. During the next 16 months of follow-up at our infectious diseases clinic, complete clinical and radiographic recovery was documented.

Discussion

In the fetal circulation, the eustachian valve directs oxygenated blood from the inferior vena cava through the foramen ovale, and into the left atrium. In adults, it is usually a rudimentary and benign nonfunctional structure. Eustachian valve endocarditis, first described in 1986 by Edwards and colleagues⁴ in a patient who died of staphylococcal septicemia and lung abscesses, is distinctly rare. Since 1986, only 29 additional cases of EV endocarditis have been reported (Table I).^{4–24} The usual predisposing factor for EV endocarditis is intravenous drug use. Other causes include indwelling catheters, rheumatic heart disease, pacemaker wires, and immunologic compromise (such as that caused by chronic alcoholism or the human immunodeficiency virus).^{12,15,18}

In the presence of intravenous drug use, the usual causative pathogen is *Staphylococcus aureus*.¹⁴ Other organisms, not specifically associated with intravenous drug use, include *Staphylococcus hominis*,⁶ *Enterobacter cloacae*,¹⁰ *Escherichia coli*,¹⁴ *Proteus vulgaris*,¹⁴ *Streptococcus viridans*,¹² *Klebsiella pneumoniae*,^{16,19} and *Actinomyces israelii*.³ Pericardial actinomycotic infections are known to occur by contiguous spread from adjacent thoracic structures. In patients with underlying rheumatic heart disease or a history of intravenous drug use,^{25,26} *Actinomyces* species are also a reported cause of aortic, mitral, and (rarely) tricuspid valve endocarditis (Table II^{27–45}). Kennedy and colleagues³ reported a case of EV endocarditis caused by *A. israelii* in an intravenous drug user who had a history of treatment for staphylococcal tricus-

pid valve endocarditis. Because of persistent fever, the patient underwent surgical excision of the vegetation.

For the diagnosis of EV endocarditis, TTE is usually the test of choice for initial imaging. Although transesophageal echocardiography might yield relatively better images of the EV, its use as an initial diagnostic tool in all patients suspected to have EV endocarditis remains controversial.^{46,47} We recommend a transesophageal echocardiogram in patients with a high clinical suspicion of endocarditis, in whom a TTE fails to accurately define cardiac structures, including the EV.

In most cases of EV endocarditis reported to date, medical therapy with appropriate antibiotics has shown resolution of the vegetations. Surgery is reserved for nonresponders or for patients with evidence of septic emboli or symptoms of congestive heart failure. Penicillin G remains the mainstay of treatment for actinomycosis. Alternative regimens for patients with allergy to penicillin include 3rd-generation cephalosporin (ceftriaxone), clindamycin, erythromycin, and doxycycline.⁴⁸

Our patient with EV endocarditis was a previously healthy young woman who acquired extensive *A. turicensis* infection of her intra-abdominal and pelvic structures mimicking malignancy, although its most likely cause was an infected IUD. Despite the absence of a cardiac histologic diagnosis in this case, several factors support the diagnosis of actinomycotic EV endocarditis: a high degree of suspicion for cardiac involvement of *Actinomyces*, a lack of evidence to support an alternative diagnosis, and successful resolution of the vegetation with antibiotic treatment. We conclude that endocarditis, particularly of the eustachian valve, should be suspected in patients who have such extensive actinomycotic infection. Prompt diagnosis and appropriate intervention is recommended to reduce the risk of such sequelae as septic emboli, congestive heart failure, and death.

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