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Case report

Staphylococcus aureus native mitral valve endocarditis associated with bed bug bites – A case report and review of the literature

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ABSTRACT

Staphylococcus aureus is a leading cause of community acquired bacteremia and infective endocarditis. *S. aureus* is a part of the normal skin flora in approximately one third of the human population. Infective endocarditis due to *S. aureus* can cause several complications and is associated with increased mortality.

A 48-year-old female with no significant medical history presented with *S. aureus* bacteremia and native mitral valve endocarditis. Multiple cutaneous skin lesions were identified, which she reported were due to recent bed bug bites. No source of infection was found except for the skin lesions. Her hospital course was complicated by pulmonary and cerebral septic emboli, left pleural empyema, and acute renal injury. We suspected the bed bug skin bites were the most likely source of bacteremia. Bed bugs carry many human pathogens but have not been shown to be a competent vector. We did not find any literature on endocarditis associated with bed bug bites; thus, our case will be a novel finding.

Introduction

Infective endocarditis (IE) is defined as infection of the endocardial surface of heart including valvular structures [1]. The incidence of IE varies across clinical centers and countries. There are about 40,000–50,000 cases annually in the United States alone [2]. Despite early detection and improved management, it is associated with about 30% 1-year mortality.[3] Among left-sided native valve infective endocarditis, mitral valve IE (MVE) is more common than aortic valve IE (AVE). *Staphylococcus aureus* is most commonly associated with MVE [4].

S. aureus, a commensal and human microbe, accounts for a majority cases of infective endocarditis in the United States. [5] *S. aureus* forms part of the normal cutaneous and mucosal flora of human species in about 30% of people [6]. Skin breakdown can introduce these bacteria into the blood resulting in bacteremia and/or infective endocarditis especially in high-risk individuals. Predisposing risk factors for IE include advanced age, male sex, injection drug use (IVDU), prior history of IE, poor dentition, structural heart disease, valvular disease, congenital heart disease, HIV, and chronic hemodialysis among others. However, it is rare for low-risk patients to develop spontaneous IE simply from skin breakdown. Patient specific risk factors for IE in the setting of *S. aureus* bacteremia include IVDU, heart valve prosthesis, intravascular catheter infection, predisposing cardiac abnormalities and persistent bacteremia [7,8].

Cimex lectularius, also commonly known as "bed bug," is a nocturnal insect that routinely feeds on humans. Bed bugs usually feeds on a blood meal as a person sleeps. Their bites usually result in erythematous and pruritic papules at the bite sites. Skin reactions to their bites may result when saliva injection leads to sensitization in some individuals. In a majority of cases, these reactions are minor and not noticeable. However, typical visualized reactions include an erythematous wheal, followed by a firm papule and often a central hemorrhagic punctum [9,10].

Theoretically, the skin lesion from a bite could result in the introduction of *S. aureus* into the bloodstream, which can lead to infective endocarditis. However, in a search of the literature, we did not find any case of IE resulting from skin lesions due to bed bug bites. We present a case of methicillin-sensitive *S. aureus* (MSSA) native mitral valve endocarditis from cutaneous bed bug bites as the potential source of MSSA bacteremia.

Case presentation

A 48-year-old female (BMI 44 kg/m^2) with no significant past medical history was transferred to our tertiary facility for potential mitral

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valve replacement due to native mitral valve infective endocarditis.

She presented initially to an outside facility with dyspnea and altered mental status. The patient had no history of illicit drug use. The patient could not provide additional history due to encephalopathy. She was noted to be in sepsis complicated by acute kidney injury and thrombocytopenia.

Blood cultures grew methicillin-sensitive *S. aureus* (MSSA. Computed tomography (CT) of the chest showed bilateral cavitary lesions located peripheral parts of lung (Fig. 1). Testing of serum anti-neutrophil cytoplasmic antibody (ANCA) panel, serum (1->3)-beta-D-glucan assay, serum Aspergillus galactomannan antigen, and HIV serology were negative. Cavitary lesions were then regarded septic emboli from MSSA bacteremia.

A transthoracic echocardiogram (TTE) did not show valvular vegetations. Given the high clinical suspicion for infective endocarditis (IE), a transesophageal echocardiogram (TEE) was performed which showed a 0.7 cm × 1.28 cm mobile echo-density on the posterior mitral valve leaflet with associated mild mitral regurgitation. There was no vegetation seen on the tricuspid valve. TEE also showed left to right interatrial shunting suggestive of an atrial septal defect (ASD), which explained the presence of septic pulmonary emboli.

Because of altered mental status, a MRI brain with and without intravenous gadolinium was performed and it showed evidence of septic cerebral emboli – a left parietal lobe cystic lesion with surrounding edema suggestive of hemorrhagic conversion (Fig. 2A) and a punctate lesion on the left cerebellum (Fig. 2B). In the settings of a large mitral valve vegetation with multiple septic emboli, the patient was transferred to our facility for potential mitral valve replacement and cardiac surgery evaluation.

On the arrival to our hospital, the patient's mentation improved. The patient was able to provide history that her house had recently undergone fumigation because of an extensive bed bug infestation. Thorough physical examination revealed several maculopapular erythematous skin lesions on upper extremities which the patient reported as bed bug bites. (Fig. 3) No other lesions including dental caries or foreign objects were identified.

The etiology of her native mitral valve endocarditis was suspected to be from introduction of MSSA bacteria through breakdown of her skin barrier due to repetitive skin scratches of bed bug bites.

Follow up

Mitral valve replacement surgery was postponed because of septic cerebral emboli. The patient was discharged to a rehabilitation center to complete 8 weeks of IV nafcillin therapy. During treatment course, nafcillin was transitioned to cefazolin due to neutropenia.

Discussion

Infective endocarditis (IE) is a serious infection associated with several complications and morbidity. As demonstrated in our case, IE can often lead to potentially fatal complications. The 1-year mortality is as high as 30% [3]. There are several risk factors for the development of IE. Most cases of IE will fall under one of these patient factors. However, our patient did not have the typical predisposing risk factors. Advanced age > 60 years old accounts for more than half of cases in developed countries. IE is also most prevalent in males than females with a ratio ranging from 3:2–9:1 in different clinical settings [11].

Previously damaged valves, history of rheumatic heart disease, congenital heart disease, prosthetic heart valves, intracardiac devices, chronic dialysis, and HIV infection have all been associated with increased risk of IE. Injection drug use is a frequent risk factor for right-sided valve endocarditis. None of the risk factors mentioned were seen in our patient. Her only comorbid condition was morbid obesity. To the best of our knowledge, there has been no study to demonstrate that obesity is a predisposing risk factor for native valve endocarditis. A study by Harris et al. used the 2013–2014 Nationwide Inpatient Sample (NIS) data to investigate the impact of obesity on hospital outcomes in patients with IE and did not find any significant association [12].

S. aureus is a highly virulent pathogen owing to high incidence of complications seen in our case. *S. aureus* bacteremia is most commonly seen in either extreme of life: first year of life and advanced age [13]. In addition to the risk factors discussed above, other patient factors that result in a weakened host immune system may increase risk of invasive *S. aureus* infections [6]. None of these risk factors were evidenced in our patient. IE complications are well known and include metastatic infections, such as paravalvular abscess, severe valvular regurgitation with heart failure, cardiac device infection, pulmonary and systemic septic emboli, and musculoskeletal infection. These complications increase the patient mortality. Our patient presented with several of these complications. *S. aureus* is more often associated with these complications than other pathogens due to its known virulent and antigenic properties [14].

Irrespective of the source of MSSA endocarditis, nafcillin or oxacillin are the mainstay antibiotic choice for MSSA native valve endocarditis. The duration therapy is usually 6 weeks but can be longer in complicated cases [15]. Patients with penicillin allergy are usually treated with cefazolin as per American Heart Association and the European Society for Cardiology guidelines [15]. Cefazolin has relatively less brain penetration, and it is not recommended as the first line therapy in

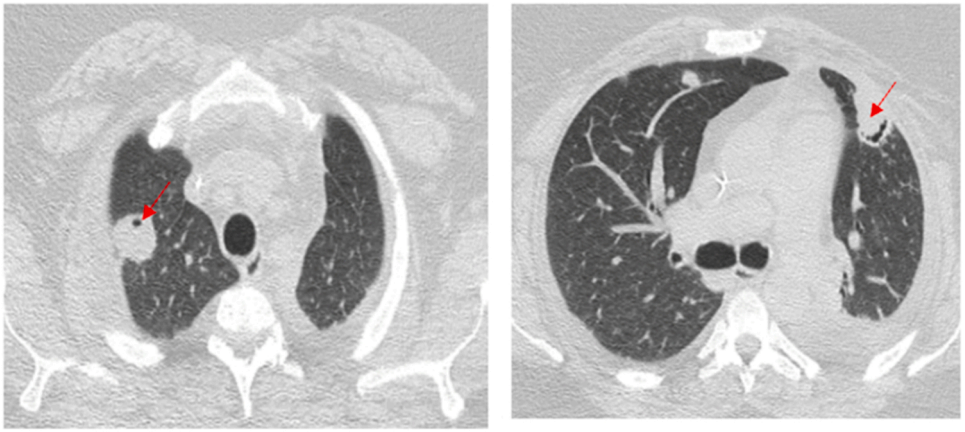

Fig. 1. A-B: CT chest with contrast showing cavitary lesions, in right and left upper lobes (red arrows). (For interpretation of the references to colour in this figure, the reader is referred to the web version of this article.)

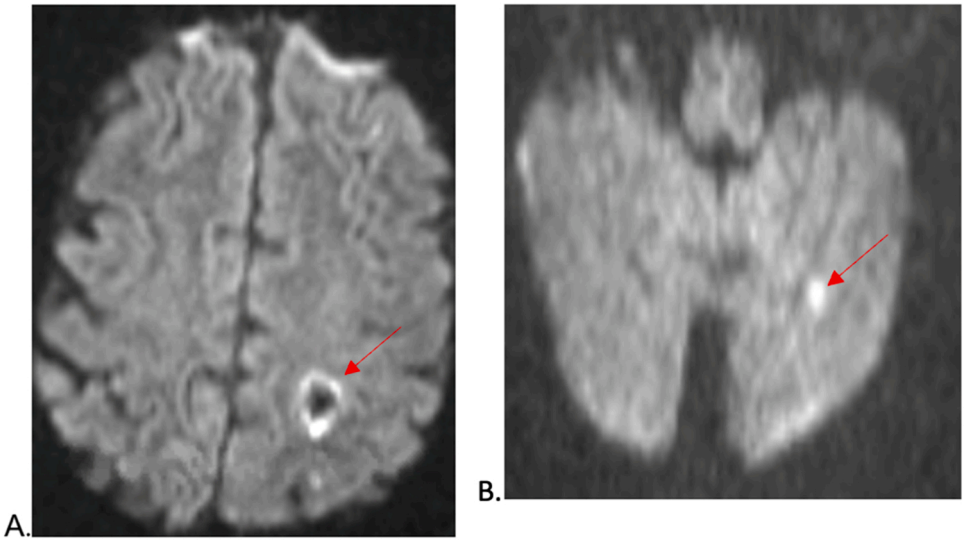

Fig. 2. A-B. Diffusion-weighted images of MRI brain. A: left, parietal lobe cystic lesion with peripheral enhancement suggestive hemorrhagic transformation, B: focal left cerebellum lesion consistent with septic emboli.

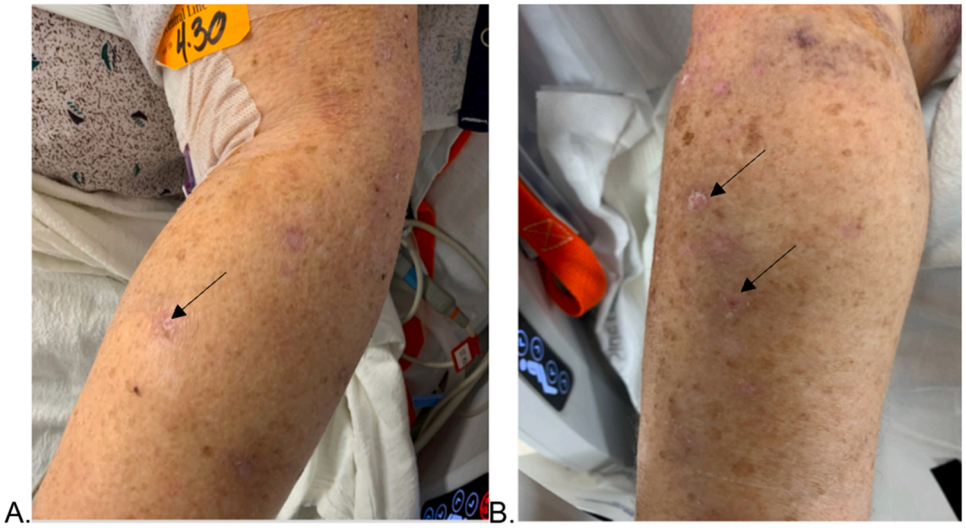

Fig. 3. Skin Findings on physical exam: Left and Right forearm, showing improved scabs from bed bug bite (Black arrows).

patients with meningitis or brain abscess. Nafcillin or oxacillin is typically preferred in these cases due to better CNS penetrance. Cefazolin can, however, be as effective as anti-staphylococcal penicillin, and could be an alternative antibiotic option in the treatment of MSSA intracerebral septic emboli, as seen in our case [16]. In our patient, nafcillin was substituted with cefazolin when profound neutropenia was caused by nafcillin.

After thorough history and physical examination, we did not find any other explanation for the source of her infection except for her skin lesions as shown in Fig. 3. There was no clinical evidence of injection sites and patient vehemently denied illicit injection drug use. She had not been recently hospitalized prior to the incident presentation, which excluded a nosocomial source. Frequent scratching of bed bug cutaneous bites may have introduced MSSA colonized on skin into blood circulation. It was in turn secondarily seeded to her mitral valve causing infective endocarditis, septic cerebral and pulmonary emboli, and left pleural empyema.

Cimex lectularius (bed bugs) are known to be infested with more than two dozen human pathogens but have not been shown to be capable of transmitting them to humans [10]. Bed bug infestations are common in economically disadvantaged homes, homes of frequent travelers or among refugees [17]. Bites present clinically as a small punctum, erythematous papule, wheals, purpuric macules or occasionally bullous reactions [18–20]. For most patients, these skin reactions are the only clinical outcome of bed bug bites. Most of these skin lesion self-resolve within a week when left untreated [21]. Occasionally, bite lesions can become secondarily infected leading to cellulitis or impetigo. Bed bugs carry pathogens such as hepatitis B virus, *Trypanosoma cruzi*, *S. aureus* (particularly methicillin resistant *S. aureus),* and *Wolbachia* among others. However, the clinical transmission of these diseases to humans has not been demonstrated in the literature [22–28]. Bed bugs have not been shown to be competent vectors for any of these pathogens [21,29].

Conclusion

Infective endocarditis is a serious infection that has high mortality and morbidity. Risk factors for IE has been well-documented. We did not find any published cases of MSSA infective endocarditis caused by bed bug bites as the suspected source of bacteremia. Our case highlights the clinical significance of thorough history taking and cutaneous

examination on identification of the potential source of this disseminated MSSA infection.

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Author contribution

Richard Amoateng: Was responsible for the article structure, obtaining patient data and clinical images. He wrote the bulk the article. Abraham Attah: Was responsible for obtaining radiology figures and formatting. He also edited the write up.Ibrahim Ahmed: contributed to formatting and editing of the article. Zaw Min and Michelle Paulson: Senior researchers on this article. They were responsible for final edits, format and content. They ensured the appropriate references were utilized in the article.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Conflict of interest

No conflicts of interest to declare.

References

[1] Mylonakis E, Calderwood SB. Infective endocarditis in adults. New Engl J Med 2001;345(18):1318–30.
[2] Bor DH, et al. Infective endocarditis in the U.S., 1998-2009: a nationwide study. PLoS One 2013;8(3):e60033.
[3] Cahill TJ, et al. Challenges in infective endocarditis. J Am Coll Cardiol 2017;69(3):325–44.
[4] Van Vlasselaer A, et al. Native aortic versus mitral valve infective endocarditis: a nationwide registry study. Open Heart 2019;6(1):e000926.
[5] Tleyjeh IM, et al. A systematic review of population-based studies of infective endocarditis. Chest 2007;132(3):1025–35.
[6] Tong SYC, et al. Staphylococcus aureus infections: epidemiology, pathophysiology, clinical manifestations, and management. Clin Microbiol Rev 2015;28(3):603–61.
[7] Hill EE, et al. Risk factors for infective endocarditis and outcome of patients with Staphylococcus aureus bacteremia. Mayo Clin Proc 2007;82(10):1165–9.
[8] Le Moing V, et al. Staphylococcus aureus bloodstream infection and endocarditis–a prospective cohort study. PLoS One 2015;10(5):e0127385.
[9] Steen CJ, Carbonaro PA, Schwartz RA. Arthropods in dermatology. J Am Acad Dermatol 2004;50(6):819–42. quiz 842-4.
[10] Kolb A, et al. Bedbugs. Dermatol Ther 2009;22(4):347–52.
[11] Hill EE, et al. Infective endocarditis: changing epidemiology and predictors of 6-month mortality: a prospective cohort study. Eur Heart J 2007;28(2):196–203.
[12] Harris CM, et al. Obesity as a risk factor among hospitalized patients with infective endocarditis. Open Forum Infect Dis 2019;6(10):ofz390.
[13] Laupland KB, et al. The changing epidemiology of staphylococcus aureus bloodstream infection: a multinational population-based surveillance study. Clin Microbiol Infect 2013;19(5):465–71.
[14] Fowler Jr VG, et al. Staphylococcus aureus endocarditis: a consequence of medical progress. Jama 2005;293(24):3012–21.
[15] Baddour LM, et al. Infective endocarditis in adults: diagnosis, antimicrobial therapy, and management of complications: a scientific statement for healthcare professionals from the american heart association. Circulation 2015;132(15):1435–86.
[16] Lecomte R, et al. Comparative outcomes of cefazolin versus antistaphylococcal penicillins in methicillin-susceptible Staphylococcus aureus infective endocarditis: a post hoc analysis of a prospective multicentre French cohort study. Clin Microbiol Infect 2021;27(7):1015–21.
[17] Gbakima AA, et al. High prevalence of bedbugs cimex hemipterus and cimex lectularis in camps for internally displaced persons in freetown, Sierra Leone: a pilot humanitarian investigation. West Afr J Med 2002;21(4):268–71.
[18] Liebold K, Schliemann-Willers S, Wollina U. Disseminated bullous eruption with systemic reaction caused by Cimex lectularius. J Eur Acad Dermatol Venereol 2003;17(4):461–3.
[19] Fletcher CL, Ardern-Jones MR, Hay RJ. Widespread bullous eruption due to multiple bed bug bites. Clin Exp Dermatol 2002;27(1):74–5.
[20] deShazo RD, et al. Bullous reactions to bedbug bites reflect cutaneous vasculitis. Am J Med 2012;125(7):688–94.
[21] Goddard J. and R. deShazo, *Bed bugs (Cimex lectularius) and clinical consequences of their bites.* Jama 2009;301(13):1358–66.
[22] Jupp PG, McElligott SE, Lecatsas G. The mechanical transmission of hepatitis B virus by the common bedbug (Cimex lectularius L.) in South Africa. S Afr Med J 1983;63(3):77–81.
[23] Jupp PG, McElligott SE. Transmission experiments with hepatitis B surface antigen and the common bedbug (Cimex lectularius L). S Afr Med J 1979;56(2):54–7.
[24] Silverman AL, et al. Assessment of hepatitis B virus DNA and hepatitis C virus RNA in the common bedbug (Cimex lectularius L.) and kissing bug (Rodnius prolixus). Am J Gastroenterol 2001;96(7):2194–8.
[25] Salazar R, et al. Bed bugs (Cimex lectularius) as vectors of Trypanosoma cruzi. Am J Trop Med Hyg 2015;92(2):331–5.
[26] Lowe CF, Romney MG. Bedbugs as vectors for drug-resistant bacteria. Emerg Infect Dis 2011;17(6):1132–4.
[27] Barbarin AM, et al. Colonization of Cimex lectularius with methicillin-resistant Staphylococcus aureus. Environ Microbiol 2014;16(5):1222–4.
[28] Brouqui P, Raoult D. Arthropod-borne diseases in homeless. Ann N Y Acad Sci 2006;1078:223–35.
[29] Ho D, et al. Lack of evidence that bedbugs transmit pathogens to humans. J Am Acad Dermatol 2016;74(6):1261.