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Chapter

Right-Sided Infective Endocarditis Secondary to Intravenous Drug Abuse

Ruchika Meel

Abstract

Right-sided infective endocarditis is due to intravenous drug abuse. Right-sided infective endocarditis is rare. It comprises 5–10% of infective endocarditis cases. Traditionally, it has been reported more commonly in patients with medical devices such as pacemakers and defibrillators and dialysis catheters. Recently, there has been increase in right-sided infective endocarditis related to intravenous drug abuse. Right-sided infective endocarditis related to drug abuse mostly affects the tricuspid valve and rarely the pulmonary valve. Although, most uncomplicated cases do well with medical treatment, it is associated with considerable morbidity and mortality due to recurrent infection. Surgery for right-sided infective endocarditis is uncommon especially in resource limited setting. Few current studies have explored surgical options in this group of patients. This chapter will review current literature related to right-sided infective endocarditis due to intravenous drug abuse.

Keywords: infective endocarditis, intravenous drug abuse

1. Introduction

Infective endocarditis (IE) is characterised by a microbial infection that involves the endocardial surface of the heart; it most often denotes infection of the heart valves or an intracardiac device [1]. Less commonly it involves septal defects, mural endocardium and the subvalvular apparatus [2]. The classic lesion is a vegetation, which is composed of platelets, fibrin enmeshed with microorganisms and inflammatory cells [3]. Infective endocarditis is caused by many different species of bacteria such as staphylococci, streptococci, enterococci and slow-growing Gram-negative coccobacilli.

In the 1950s IE secondary to intravenous drug use was first described [4]. Right-sided infective endocarditis (RSIE) secondary to intravenous drug use is a distinct entity and will be reviewed in this chapter.

2. Epidemiology

Intravenous drug abuse (IVDA) is a recognised risk factor for IE. Intravenous drug users are at a seven times higher risk for infective endocarditis compared to patients with rheumatic heart disease or prosthetic valves [3].

Over the last decade there has been a steady increase in number of cases related to IE due to intravenous drug use. Between 2000 and 2008 the rate of IE due to IVDA has increased from 6 to 8% hospitalisation to 12% in the year 2013. During this period there has been an increase in IVDA related IE cases amongst younger white population. A similar distribution was noted between males and females [5].

In United States, North Carolina, a study reported a 12-fold increase in hospitalisations for intravenous drug use related IE over the last decade [6].

In the past IE related to IVDA was predominantly disease of men. A recent study has shown that there is a general increase in the rate of IVDA associated IE in the United States, with a relatively higher proportion of women compared to previous studies [5, 6]. In a recent South African Study, Meel et al. reported an increase in the incidence of IE related to IVDA amongst Africans. These were predominantly male and majority were HIV infected [7].

Infective endocarditis involving the right side accounts for 5–10% of cases of IE [8, 9].

RSIE may occur in patients with intracardiac devices but in intravenous drug users it is usually associated with HIV infection [9].

HIV infection in intravenous drug users is associated with a higher rate of IE compared to HIV uninfected users [10, 11]. Further, immunosuppression with lower CD4 count is associated with a higher predisposition to IE [9].

Intravenous drug use related IE involves the tricuspid valve in 46–78% of the cases, mitral valve in 24–32% of cases and the aortic valve in 8–19%. About 16% of the patients have multiple valve involvement. In the majority the infection occurs on the native valves. Intravenous drug use is characterised by recurrent infective endocarditis of the native valves [3].

3. Etiopathogenesis

The most common organism isolated in IVDA related IE is *Staphylococcus aureus*. It accounts for greater than 50% of the organisms cultured [3]. It tends to commonly infect the native tricuspid valve. In contrast streptococci and enterococci infect damaged valves, mostly aortic and the mitral valve. Other organisms include fungi, *Pseudomonas aeruginosa* and Gram-negative bacilli. Injection of contaminated material predisposes drug addicts to less commonly encountered organisms such as *Corynebacterium* species, *Lactobacillus*, *Neisseria* species and *Bacillus cereus*. In 3–5% of cases Polymicrobial infection is present [3].

The tricuspid valve is the most commonly involved valve in RSIE due to IVDA. Injection of recreational drugs results in entry of particulate matter such as talc into the circulatory system resulting in structural damage to the endothelium of the valve [12, 13]. Similarly, the left-sided valves get damaged by particulate matter that is less than 10 mm in size and is able to cross the pulmonary circulation [14]. The use of cocaine is associated with greater frequency of IE in IVDA. The possible mechanisms postulated include the ability of cocaine to cause vasospasm and tissue damage to the myocardium. It is also procoagulant and thus can cause thrombus formation and thus producing a nidus for bacterial seeding the damaged valve tissue [8]. Further, it has been postulated that intravenous drugs can result in pulmonary hypertension leading to increased turbulent blood flow across the valve resulting in endothelial damage to the right-sided heart valves.

The pathogenesis of formation of vegetation is complex. It involves interaction between the host, the organism, the endothelium, hemostatic pathways, the ability of the hosts immune system to eliminate the organism and the virulence of the specific microorganism [3].

The microorganism once in the blood stream tend to attach themselves to the valve surface and proliferate at sites of endothelial damage resulting in further damage to the valve tissue. The microorganisms initially attach to the platelet-fibrin nidus and then proliferate [15]. Microbial growth results in activation of the extrinsic coagulation pathway, monocytes release a myriad of pro-inflammatory cytokines and there is increased expression of fibronectin on the surface of the endothelial cells with resultant formation of a vegetation.

The vegetation grows further, with subsequent embolization and continued bacteraemia, if the host is unable to contain the infection [16].

4. Clinical features

Right-sided infective endocarditis usually presents with fever, persistent bacteraemia and septic emboli to the lungs. Initial presentation may comprise haemoptysis, cough or chest pain. Peripheral embolization must alert one to the presence of concomitant left-sided endocarditis or a shunt. Right heart failure is a result of both pressure and volume overload from pulmonary hypertension or organic tricuspid regurgitation or rarely obstruction of the tricuspid orifice by a vegetation [17, 18].

Pulmonary septic emboli may be complicated by pulmonary infarction, abscess, pneumothorax, and purulent pulmonary effusion [17] (**Figures 1** and **2**).

It is important to note that patients with RSIE do not always have an audible murmur of tricuspid regurgitation [13]. Other features unique to this group of patients with IE are the presence of co-infections with HIV, hepatitis C and hepatitis B infections, which complicate their clinical management and adversely affect their outcomes. A high degree of suspicion of IE must be maintained in IVDA as their clinical assessment can be quite challenging, especially in those who do not manifest the classic clinical features.

Additionally, the sensitivity and specificity of the modified Duke's criteria in right-sided endocarditis has not been studied. Inclusion of septic pulmonary infarcts as a minor criteria in the modified Duke's criteria may therefore be inappropriate [19].

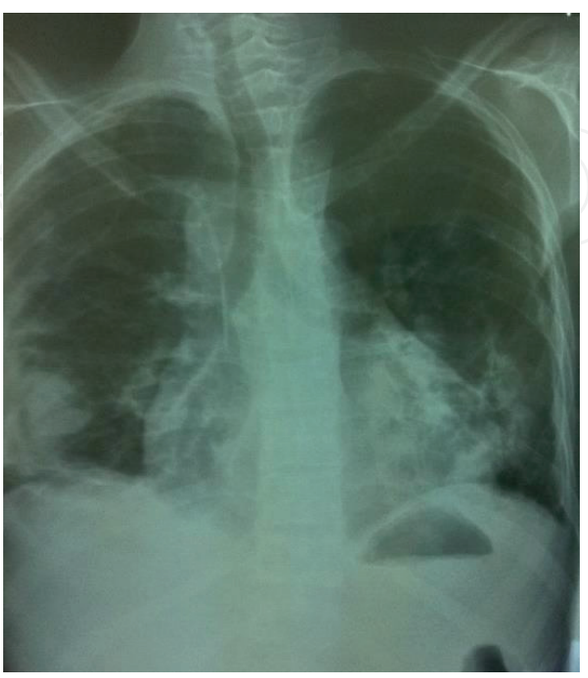


Figure 1.
An anterior-posterior chest X-ray showing increased cardiothoracic index with areas of alveolar opacification involving both lung fields likely representing septic embolization and abscess formation in the lungs.

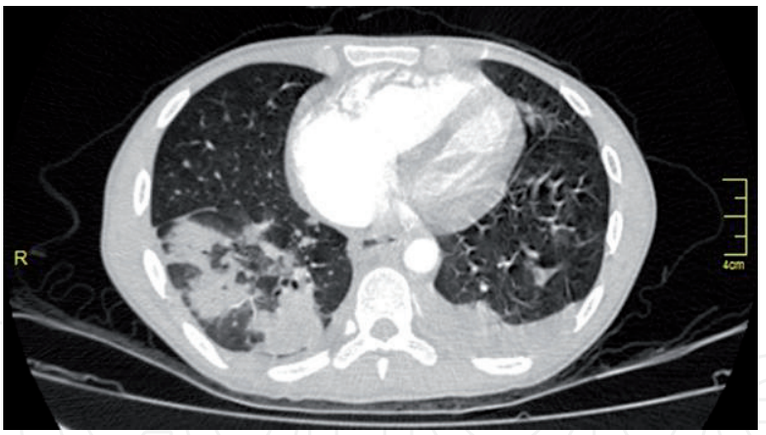


Figure 2.
Multiple areas of consolidation suggestive of infarction and dilated right heart chambers on a CT scan of the chest of a patient with history of right-sided infective endocarditis due to intravenous drug abuse.

5. Diagnosis

In addition to the above mentioned clinical features and positive blood cultures, transthoracic echocardiography (TTE) greatly aids in establishing a diagnosis of IE,

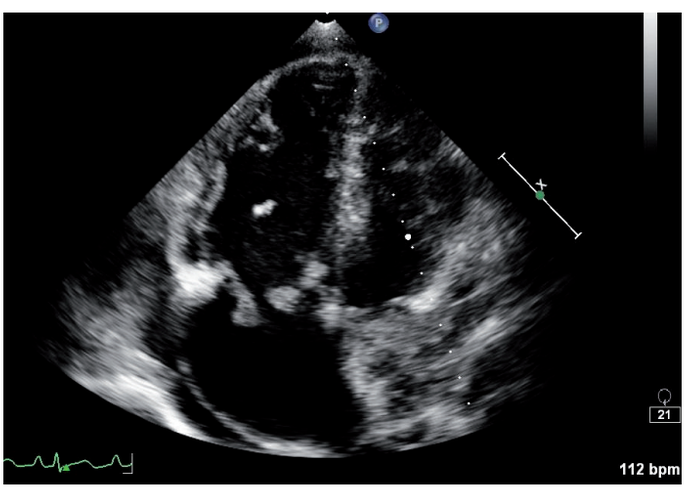


Figure 3.
Modified apical four-chamber view showing multiple vegetations on the tricuspid valve (arrow) with a dilated right atrium and right ventricle.

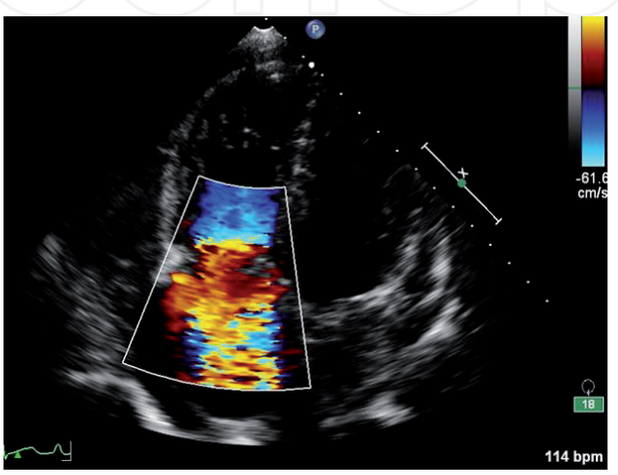


Figure 4.
Colour Doppler ultrasound showing severe tricuspid regurgitation.

especially in cases with equivocal clinical presentation. TTE allows easy visualisation of vegetations on the anteriorly located tricuspid valve and associated tricuspid regurgitation (**Figures 3** and **4**) [20, 21].

A transesophageal echocardiography may be required in detection of vegetations on the pulmonary valve and for exclusion of left-sided valve involvement [22]. The Eustachian valve must be screened for presence of vegetations.

6. Management

The initial antimicrobial therapy should take into account four factors: (1) suspected organism (2) type of drug (3) the solvent used by the addict and (4) the location of Infection [17].

Empirical therapy in acute severely ill patients must consist of ampicillin and cloxacillin with gentamycin or vancomycin with gentamycin (in patients allergic to penicillin) [17]. *Staphylococcus aureus* must always be covered. Anti-pseudomonas agent must be added in a pentazocine drug addict. If an IVDA gives a history of brown heroin use mixed with lemon juice then an anti-fungal agent must be added due to a high risk of candida septicaemia. Anti-microbial therapy can be de-escalated once the specific causative organism is isolated on blood cultures.

Due to reluctance of IVDA for prolonged hospital admission and the concerns related to their discharge on intravenous antibiotic therapy, a few studies have studied the possibility of treating IE in these patients with short course antibiotic therapy [23].

A 2 week treatment regimen has been advocated in non-complicated isolated tricuspid valve endocarditis. These patients must have low risk features such as good response to therapy, methicillin sensitive *Staphylococcus aureus*, small vegetation size (less than 20 mm), no features of peripheral embolization, absence of metastatic infection, lack of involvement of left-sided valves or prosthetic valve and absence of a severely immunosuppressed state. In such cases, a short 2 week course of intravenous cloxacillin or oxacillin alone may be used [24]. These patients must be closely followed up and the response to therapy must be assessed.

In complicated cases a 4–6 week course of intravenous therapy must be utilised. These include situations where there is poor response to antibiotic therapy, large vegetation size (>20 mm), septic emboli, use of penicillinase non-resistant antibiotics, and a severely immunosuppressed state such as HIV with a CD4 count less than 200cell/ml and associated involvement of left-sided valves [25–27].

Due to a high rate of recurrent IE in IVDA, surgery should only be considered in the following situations: (1) intractable right-sided heart failure with poor response to diuretics; (2) persistent bacteraemia despite use of appropriate antimicrobial therapy; and (3) large vegetation size of greater than 20 mm that do not diminish in size after repeated episodes of pulmonary emboli [25, 28, 29].

In general the outcomes of patients with IVDA related IE have been poor post surgery. A substantially high long term mortality has been reported for IE related surgery in IVDA compared to non-drug users [30–32].

In HIV-infected IVDAs with IE cardiac surgery does not worsen the outcome of either the IE or the HIV [17]. Patients with advanced HIV infection with severe immunosuppression. However, valve replacement surgery may have unacceptably high risks in selected patients with advanced HIV infection, low CD4 counts, and either a history of failed antiretroviral therapy or ongoing drug abuse that precludes therapy with antiretroviral agents [33].

The most commonly performed surgery for tricuspid valve endocarditis includes valvectomy, valve replacement or repair [34]. Valve repair is advocated by some studies but repair has not proven to be superior to either valve replacement or

valvectomy. In a few cases of RSIE valvectomy may be performed initially followed by subsequent bioprosthetic valve replacement once the infection has subsided and drug use discontinued. Pulmonary valve rarely requires replacement except in extreme cases of valve destruction. In cases where pulmonary valve replacement is deemed suitable, a homograft is preferred.

7. Prognosis

Overall, IVDA with RSIE have a lower mortality than those with left-sided infective endocarditis [14, 24, 35–39]. In one study the mortality was noted to be 6% [40]. Factors associated with high mortality included a large vegetation size (>20 mm) and a fungal aetiology [41, 42].

In general patients with HIV do not have a poor outcome, except those with CD4 count <200 cells/ml. The major reason for repeat hospitalisation and recurrent endocarditis in IVDA is related to persistent use of drugs [30, 43, 44].

Finally, management of RSIE related to IVDA poses some ethical dilemmas. From the limited available literature, surgery should be offered for patients with surgical indications, with a first episode of IE in IVDAs, who are willing to undergo rehabilitation. If the patient presents with a second episode of IE due to recurrent IVDA, the decision to re-operate the patient, if indicated, is complex. It should be individualised and discussed by the endocarditis team. It is reasonable to decline further surgical intervention in this group, especially in resource-limited settings [45].

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References

[1] Sexton DJ, Fowler VG. Clinical manifestations and evaluation of adults with suspected native valve endocarditis. U: UpToDate. Otto CM, ur., Baron EL, ur. UpToDate (Internet). 2017:1-50

[2] Mylonakis E, Calderwood SB. Infective endocarditis in adults. New England Journal of Medicine. 2001;**345**:1318-1330

[3] Lilly LS, Braunwald E. Braunwald's Heart Disease: A Textbook of Cardiovascular Medicine. Philadelphia: Elsevier Health Sciences; 2012

[4] Hussey HH, Katz S. Infections resulting from narcotic addiction; report of 102 cases. The American Journal of Medicine. 1950;**9**:186

[5] Wurcel AG, Anderson JE, Chui KK, et al. Increasing infectious endocarditis admissions among young people who inject drugs. Open Forum Infectious Diseases. 2016;**3**:ofw157

[6] Schranz AJ, Fleischauer A, Chu VH, et al. Trends in drug use-associated infective endocarditis and heart valve surgery, 2007 to 2017: A study of Statewide discharge data. Annals of Internal Medicine. 2019;**170**:31-40

[7] Meel R, Essop M. Striking increase in the incidence of infective endocarditis associated with recreational drug abuse in urban South Africa. South African Medical Journal. 2018;**108**(7):585-589

[8] Frontera JA, Gradon JD. Right-side endocarditis in injection drug users: Review of proposed mechanisms of pathogenesis. Clinical Infectious Diseases. 2000;**30**:374-379

[9] Wilson LE, Thomas DL, Astemborski J, Freedman TL, Vlahov D. Prospective study of infective endocarditis among injection drug users. The Journal of Infectious Diseases. 2002;**185**:1761-1766

[10] Spijkerman IJ, van Ameijden EJ, Mientjes GH, et al. Human immunodeficiency virus infection and other risk factors for skin abscesses and endocarditis among injection drug users. Journal of Clinical Epidemiology. 1996;**49**:1149

[11] Manoff SB, Vlahov D, Herskowitz A, et al. Human immunodeficiency virus infection and infective endocarditis among injecting drug users. Epidemiology. 1996;**7**:566

[12] Weinstein WL, Brusch JL. Infective Endocarditis. New York City: Oxford University Press; 1996

[13] Sande MA, Lee BL, Mills J, et al. Endocarditis in intravenous drug users. In: Kaye D, editor. Infective Endocarditis. New York City: Raven Press; 1992. p. 345

[14] Mathew J, Addai T, Anand A, et al. Clinical features, site of involvement, bacteriologic findings, and outcome of infective endocarditis in intravenous drug users. Archives of Internal Medicine. 1995;**155**:1641

[15] Durack DT, Beeson PB. Experimental bacterial endocarditis. I. Colonization of a sterile vegetation. British Journal of Experimental Pathology. 1972;**53**:44

[16] Werdan K, Dietz S, Löffler B, et al. Mechanisms of infective endocarditis: Pathogen-host interaction and risk states. Nature Reviews. Cardiology. 2014;**11**:35

[17] Habib G, Lancellotti P, Antunes MJ, Bongiorni MG, Casalta JP, Del Zotti F, Dulgheru R, El Khoury G, Erba PA, Iung B, Miro JM. 2015 ESC guidelines for the management of infective endocarditis: The task force for the management of infective endocarditis of the European Society of Cardiology (ESC)

endorsed by: European Association for Cardio-Thoracic Surgery (EACTS), the European Association of Nuclear Medicine (EANM). European Heart Journal. 2015;**36**:3075-3128

[18] Carozza A, De Santo LS, Romano G, Della CA, Ursomando F, Scardone M, et al. Infective endocarditis in intravenous drug abusers: Patterns of presentation and long-term outcomes of surgical treatment. The Journal of Heart Valve Disease. 2006;**15**:125-131

[19] Westphal N, Plicht B, Naber C. Infective endocarditis—Prophylaxis, diagnostic criteria, and treatment. Deutsches Ärzteblatt International. 2009;**106**(28-29):481

[20] San Roman JA, Vilacosta I, Lopez J, Revilla A, Arnold R, Sevilla T, et al. Role of transthoracic and transesophageal echocardiography in right-sided endocarditis: One echocardiographic modality does not fit all. Journal of the American Society of Echocardiography. 2012;**25**:807-814

[21] San Roman JA, Vilacosta I, Zamorano JL, Almeria C, Sanchez-Harguindey L. Transesophageal echocardiography in right-sided endocarditis. Journal of the American College of Cardiology. 1993;**21**:1226-1230

[22] Winslow T, Foster E, Adams JR, Schiller NB. Pulmonary valve endocarditis: Improveddiagnosis with biplane transesophageal echocardiography. Journal of the American Society of Echocardiography. 1992;**5**:206-210

[23] Suzuki J, Johnson J, Montgomery M, et al. Outpatient parenteral antimicrobial therapy among people who inject drugs: A review of the literature. Open Forum Infectious Diseases. 2018;**5**:ofy194

[24] Ribera E, Gomez-Jimenez J, Cortes E, del Valle O, Planes A, Gonzalez-Alujas T, et al. Effectiveness of cloxacillin with and without gentamicin in short-term therapy for right-sided *Staphylococcus aureus* endocarditis. A randomized, controlled trial. Annals of Internal Medicine. 1996;**125**:969-974

[25] Hecht SR, Berger M. Right-sided endocarditis in intravenous drug users. Prognostic features in 102 episodes. Annals of Internal Medicine. 1992;**117**:560-566

[26] Fortun J, Pérez-Molina JA, Añón MT, Martinez-Beltran J, Loza E, Guerrero A. Right-sided endocarditis caused by *Staphylococcus aureus* in drug abusers. Antimicrobial Agents and Chemotherapy. 1995;**39**:525-528

[27] Pulvirenti JJ, Kerns E, Benson C, Lisowski J, Demarais P, Weinstein RA. Infective endocarditis in injection drug users: Importance of human immunodeficiency virus serostatus and degree of immunosuppression. Clinical Infectious Diseases. 1996;**22**:40-45

[28] Akinosoglou K, Apostolakis E, Koutsogiannis N, Leivaditis V, Gogos CA. Rightsided infective endocarditis: Surgical management. European Journal of Cardio-Thoracic Surgery 2012;**42**:470-479

[29] Botsford KB, Weinstein RA, Nathan CR, Kabins SA. Selective survival in pentazocine and tripelennamine of *Pseudomonas aeruginosa* serotype O11 from drug addicts. The Journal of Infectious Diseases. 1985;**151**:209-216

[30] Rabkin DG, Mokadam NA, Miller DW, et al. Long-term outcome for the surgical treatment of infective endocarditis with a focus on intravenous drug users. The Annals of Thoracic Surgery. 2012;**93**:51

[31] Thalme A, Westling K, Julander I. In-hospital and long-term mortality in infective endocarditis in injecting drug users compared to non-drug users:

A retrospective study of 192 episodes. Scandinavian Journal of Infectious Diseases. 2007;**39**:197

[32] Kim JB, Ejiofor JI, Yammine M, et al. Surgical outcomes of infective endocarditis among intravenous drug users. The Journal of Thoracic and Cardiovascular Surgery. 2016;**152**:832

[33] Sexton DJ, Chu VH. Epidemiology, Risk Factors and Microbiology of Infective Endocarditis. Waltham: UpToDate; 2011

[34] Gaca JG, Sheng S, Daneshmand M, Rankin JS, Williams ML, O'Brien SM, et al. Current outcomes for tricuspid valve infective endocarditis surgery in North America. The Annals of Thoracic Surgery. 2013;**96**:1374-1381

[35] Ortiz-Bautista C, López J, García-Granja PE, et al. Current profile of infective endocarditis in intravenous drug users: The prognostic relevance of the valves involved. International Journal of Cardiology. 2015;**187**:472

[36] Abrams B, Sklaver A, Hoffman T, Greenman R. Single or combination therapy of staphylococcal endocarditis in intravenous drug abusers. Annals of Internal Medicine. 1979;**90**:789

[37] Menda KB, Gorbach SL. Favorable experience with bacterial endocarditis in heroin addicts. Annals of Internal Medicine. 1973;**78**:25

[38] DiNubile MJ. Short-course antibiotic therapy for right-sided endocarditis caused by *Staphylococcus aureus* in injection drug users. Annals of Internal Medicine. 1994;**121**:873

[39] Mathew J, Abreo G, Namburi K, et al. Results of surgical treatment for infective endocarditis in intravenous drug users. Chest. 1995;**108**:73

[40] Martín-Dávila P, Navas E, Fortún J, et al. Analysis of mortality and risk factors associated with native valve endocarditis in drug users: The importance of vegetation size. American Heart Journal. 2005;**150**:1099

[41] Robbins MJ, Frater RW, Soeiro R, et al. Influence of vegetation size on clinical outcome of right-sided infective endocarditis. The American Journal of Medicine. 1986;**80**:165

[42] Bayer AS, Blomquist IK, Bello E, et al. Tricuspid valve endocarditis due to *Staphylococcus aureus*. Correlation of two-dimensional echocardiography with clinical outcome. Chest. 1988;**93**:247

[43] Østerdal OB, Salminen PR, Jordal S, et al. Cardiac surgery for infective endocarditis in patients with intravenous drug use. Interactive Cardiovascular and Thoracic Surgery. 2016;**22**:633

[44] Rosenthal ES, Karchmer AW, Theisen-Toupal J, et al. Suboptimal addiction interventions for patients hospitalized with injection drug use-associated infective endocarditis. The American Journal of Medicine. 2016;**129**:481

[45] Yeo KK, Chang WS, Lau JM, et al. Valve replacement in endocarditis: Setting limits in noncompliant intravenous drug abusers. Hawaii Medical Journal. 2006;**65**:168-171