Case Conference

Simultaneous Right-Sided and Left-Sided Infective Endocarditis: Management Challenges in a Multidisciplinary Setting

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INFECTIVE ENDOCARDITIS (IE) is a life-threatening disease with significant mortality.1,2 Without treatment, the majority of patients with IE will not survive.2,3 Therefore, it is critical that the diagnosis of this challenging disease process be prompt and comprehensive.1–3 Echocardiography plays a central role in diagnosis through its ability to be used to detect endocardial involvement by an infective process in the forms of vegetation and/or abscess, as defined in the revised Duke diagnostic criteria for IE.3,4 Not only should perioperative echocardiographers be familiar with the spectrum of IE, they also should focus the comprehensive echocardiographic examination to delineate precisely not only the diagnosis but also the extent of IE.4,5 This case conference explores these aspects in a challenging case of simultaneous right- and left-sided IE.

Case Report*

A 22-year-old female with a history of congenital membranous ventricular septal defect (VSD), intravenous recreational drug exposure, and chronic anemia presented to an outside hospital with acute shortness of breath and chest tightness. She had been evaluated by her primary care physician 2 months prior for fever, dyspnea, fatigue, nonproductive cough, and pleuritic chest pain and was diagnosed with pneumonia. Given

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her recent diagnosis of pneumonia and worsening symptoms, a computed tomography scan of the chest was obtained to evaluate for interim change, which revealed multifocal pneumonia. An admission electrocardiogram demonstrated anterior ST elevation. A transthoracic echocardiogram (TTE) revealed the previous VSD but no overt endocardial infection; no vegetations were detected. Her significant laboratory studies included a serum hemoglobin of 6 g/dL, a serum creatinine of 2.7 mg/dL, and significant elevations of troponin and B-type natriuretic peptide. The patient was transferred to the authors’ center for further management.

The patient was admitted to the intensive care unit in congestive heart failure, where she underwent aggressive multidisciplinary medical management, including oxygen therapy, serial blood cultures, broad-spectrum antibiotics, red blood cell transfusion, and diuresis. Comprehensive TTE demonstrated a mildly dilated left ventricle with an ejection fraction of 50% to 55% with apical akinesis, mildly reduced right ventricular function, severe aortic regurgitation, moderate mitral regurgitation, and a restrictive membranous VSD (11 mm by 17 mm) with left-to-right shunting. At that point, there was significant endocardial involvement by IE as evidenced by a large mitral valve vegetation, a smaller aortic valve vegetation, and vegetations on the right ventricular side of the VSD. Given that coronary artery disease would be unlikely at her age without additional risk factors, her manifest myocardial ischemia was attributed to septic coronary emboli. Left-heart catheterization subsequently demonstrated widely patent coronary arteries with the exception of a distal left anterior descending artery occlusion, likely due to emboli. Right-heart catheterization demonstrated pulmonary artery pressures of 60/33 mmHg, consistent with significant pulmonary hypertension. The ratio of pulmonary blood flow-to-systemic blood flow was 1.1:1 based on catheterization data. Her blood cultures before antibiotics grew Streptococcus mitis that was sensitive to ceftriaxone. After rapid medical stabilization of the IE, cardiac surgery was planned for resection of the IE, cardiac surgery was planned for resection of the IE, cardiac surgery was planned for resection of the IE. In the midesophageal long-axis view of the aortic valve, a restrictive perimembranous VSD is evident. Vegetations also are evident on the right ventricular side of the VSD, as demonstrated by the red arrows. Pulmonary embolization of these vegetations was the likely mechanism for the multifocal pneumonia that was present on admission to the hospital.

Detected during color-flow Doppler examination (Fig 3). The pulmonic valve appeared to be free of infection, although color-flow Doppler examination revealed a high-velocity jet from the aortic root to the right ventricular outflow tract consistent with an aortocardiac fistula (Fig 4). Additional aortic imaging demonstrated an abscess in the aortic root that likely was the source of the fistula (Fig 5). There was low normal biventricular systolic function. All these findings were discussed with the surgical team, including the newly detected aortocardiac fistula.

After heparinization and the initiation of CPB and aortic clamping, the heart was examined during cardioplegic arrest. The echocardiographic findings were all confirmed, including the restrictive VSD, the aortic root abscess, and the fistula from the aortic root to the right ventricular outflow tract. After extensive debridement to clear all infected tissue, the aortic root was replaced with a porcine bioroot.6,7 The aortic fistula and the VSD were both repaired with tailored autologous pericardium after adequate local debridement of all infected...
tissue. The mitral valve also was reconstructed after debridement with patch repair and band annuloplasty.

The patient was separated from CPB successfully with titrated inotropic support. After protamine administration, further coagulopathy was corrected with titrated desmopressin and fresh frozen plasma. Intraoperative anemia was managed with titrated transfusion of red blood cells. After CPB, TEE examination demonstrated competent aortic and mitral valves and normal biventricular systolic function with no evidence of the VSD or aortocardiac fistula. After standardized admission to the cardiothoracic surgical intensive care unit, the remaining postoperative course was uneventful, with hospital discharge 1 week later. The tissue cultures from surgery were consistent with *S. mitis*. Additional aggressive antibiotic therapy was arranged on an outpatient basis in compliance with the recommendations from the infectious disease service.

Discussion

The spectrum of IE has continued to evolve, rendering the diagnosis and management in complex cases major perioperative challenges, as illustrated in this case conference.3–5 The modified Duke criteria are applied widely for the diagnosis of IE (Table 1).8,9 Based on these criteria, the diagnosis of IE is confirmed by 1 of the following scenarios: infected heart tissue confirmed pathologically, 2 major criteria, 1 major and 3 minor criteria, or 5 minor criteria.3,8,9 The central role of comprehensive echocardiography is readily apparent in the modified Duke criteria for the diagnosis of IE because it is 1 of 2 major criteria for the diagnosis (see Table 1).

When IE is suspected, the patient’s history can help guide the echocardiographer in focusing the examination. As outlined, proven risk factors include intravenous recreational drug exposure, structural heart disease, recent invasive procedures, prosthetic hardware, and history of endocarditis.3–5 In this presented case, the patient was predisposed to IE due to her bicuspid aortic valve, VSD, and drug exposure. Intravenous drug exposure should prompt the echocardiographic examiner to evaluate carefully for right-sided endocarditis, including the tricuspid valve. Even though the presented patient did not

![Fig 3. Severe aortic regurgitation. In the midesophageal long-axis view of the aortic valve, there is severe aortic regurgitation during color-flow Doppler examination, as evidenced by the regurgitant jet that fills the entire left ventricular outflow tract during diastole. Furthermore, there is diastolic left-to-right shunting through the restrictive perimembranous ventricular septal defect.](image-url)

![Fig 4. Aortocardiac fistula. In a modified midesophageal aortic short-axis view just above the level of the aortic valve, the aortic defect is apparent at the level of the pulmonic valve (left panel). In the right panel, color-flow Doppler examination reveals high-velocity flow across the aortic fistula into the right ventricular outflow tract (RVOT) just below the pulmonary valve (PA - Pulmonary Artery).](image-url)

![Fig 5. Aortic root abscess. In a modified midesophageal aortic valve long-axis view, there is thickening and cavity formation in the anterior aortic root, consistent with the formation of an aortic root abscess. This local invasion by the entrenched infection likely was responsible for the fistulous extension into the adjacent pulmonary artery and right ventricular outflow tract (see Fig 4).](image-url)

<table>
<thead>
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<th>Major Criteria</th>
<th>Minor Criteria</th>
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<td>Persistently positive blood cultures with typical organisms (eg, <em>Staphylococcus</em> species, <em>Streptococcus</em> species)</td>
<td>Known predisposing factors (eg, cardiac lesions such as bicuspid aortic valve and ventricular septal defect, recreational drug injection)</td>
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<tr>
<td>Echocardiographic evidence of endocardial involvement (eg, vegetations, abscess, fistula)</td>
<td>Persistent fever</td>
</tr>
<tr>
<td>Evidence of embolism</td>
<td>Positive blood cultures (not meeting the definition as a major criterion)</td>
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<td>Immunologic phenomena</td>
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Modified from Bedeir et al.3

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appear to have direct infectious involvement of the tricuspid valve, multiple vegetations were noted below the tricuspid valve on the right ventricular side of her congenital VSD.

A VSD also is a known risk factor for right-sided IE due to left-to-right shunting.\textsuperscript{3,4,10} Furthermore, IE is a known complication in patients with bicuspid aortic valves.\textsuperscript{8–11} The incidence of bicuspid aortic valve in IE has been reported to be as high as 25%, including the development of perianular complications, such as abscess and fistula.\textsuperscript{11,12} This incidence is disproportionately high, given that bicuspid aortic valves only affect 1% to 2% of the general population.\textsuperscript{1,12}

Although TTE can be used readily to diagnose IE, it has a significantly lower negative predictive value than TEE both for the presence and extent of IE, as highlighted in this case conference.\textsuperscript{1–3} In practice this means that if clinical suspicion is high, TEE is indicated for the diagnosis of IE, even if TTE is negative.\textsuperscript{1–3,5,8,9} Despite the combined diagnostic power of TTE and TEE, about 15% of patients with proven IE will have no echocardiographic evidence of this serious infection.\textsuperscript{13} In this patient, preoperative TTE was diagnostic both for the diagnosis and for surgical indications such as severe native aortic regurgitation, right-sided embolism to the lung, left-sided embolism to the coronary arteries, and resection of infectious burden.\textsuperscript{1} Although comprehensive TEE before CPB confirmed all these findings, the full extent of her disease still was not fully delineated until this point in the operating room before CPB. It was during this comprehensive examination that additional findings were noted. First, in visualizing the ascending aorta, a portion was suspicious for abscess. Second, when evaluating the pulmonic valve, a high-velocity jet was in close proximity to the pulmonic valve and moved parallel to the pulmonic valve. Although this initially was believed to represent eccentric pulmonic insufficiency, the parallel trajectory of the blood flow seemed atypical without additional pathology such as leaflet prolapse or restriction. After further investigation, both during TEE and during cardioplegic arrest on CPB, a fistula from the aortic root to the upper right ventricular outflow tract was diagnosed (see Figs 3–5).

Aortic fistulae to the right heart in complex IE have been described previously but remain rare occurrences.\textsuperscript{14,15} They may be due to the small area of anatomic overlap between the aorta and right ventricular outflow tract.\textsuperscript{14,15} There are a number of scenarios in which this type of fistulization most has commonly been reported. The first scenario, as in the case of this presented patient, was endocarditis.\textsuperscript{14–16} In a series of 346 patients with IE, 9 were found to have fistulae between the aorta and other cardiac chambers, yielding a reported incidence of 2.6%.\textsuperscript{16} Of these 9, only 2 involved the right ventricle.\textsuperscript{10} The second scenario for aortocardiac fistula is during trauma. The right ventricle has been described as the chamber that commonly is involved in penetrating chest injuries due to its anterior location, with aorto-right ventricular fistulae described within this population.\textsuperscript{17–19} The third clinical scenario for this complication includes rarer situations such as transcatheter aortic valve replacement and complicated aortic aneurysm.\textsuperscript{20–22}

Although the aortic fistula was diagnosed using TEE, aortography also is considered a gold standard for its diagnosis.\textsuperscript{23} Due to a lack of suspicion for this complication, aortography was not performed. Although it remains possible that the fistula could have been discovered using preoperative TEE, it is more likely that TTE lacked the sensitivity to detect this invasive complication of IE, as outlined earlier.\textsuperscript{24} In one clinical trial, TTE only had a sensitivity of 55% for vegetations consistent with IE.\textsuperscript{25} The perioperative echocardiographer therefore should perform a careful and comprehensive TEE to elucidate the diagnosis and extent of IE in the patient presenting for surgical management.\textsuperscript{13,14}

In the setting of aortomitril endocarditis, as in this patient, it remains essential for the perioperative echocardiographer to examine the aortomitril continuity to investigate for perianular extension (Figs 5 and 6).\textsuperscript{3–5,13,14} In less extensive cases, direct repair or pericardial patch repair will suffice after wide local excision (see Fig 6), as illustrated in this case conference. In more extensive cases, surgical reconstruction may require aortic root replacement and wide aortomitril patching with the anterior mitral leaflet from the aortic root allograft (Fig 7).\textsuperscript{3–7} In this presented patient, there was local extension of the aortic root abscess in an anterior direction into the upper right ventricular outflow tract rather than posteriorly toward the aortomitril curtain.

Clinically, large aortic fistulae can present with heart failure.\textsuperscript{24} In this patient, the aortic fistula appeared small and likely did not contribute significantly to the patient’s presenting symptomatology. The chest pain in this scenario likely was due to myocardial ischemia from septic coronary emboli, also explaining the apical akinesis noted on preoperative TTE. Myocardial infarction caused by septic emboli is a known but uncommon complication of IE.\textsuperscript{25,26} Given this patient’s young age, lack of additional risk factors, and lack of critical coronary disease, this was determined to be the most likely diagnosis.

This patient’s complex clinical scenario ultimately led to her referral for surgical management. Common indications for surgery in IE include congestive heart failure, severe valvular regurgitation, embolic events, large vegetations, fistula formation, abscess development, stroke, persistent sepsis, difficult organisms (particularly \textit{S. aureus} and fungi), or prosthetic valve infection.\textsuperscript{27,28} Early surgery for this patient was indicated because she met the first 4 of the aforementioned criteria.

Currently, there is ongoing discussion regarding the optimal timing of early surgery. The American Heart Association/ American College of Cardiology guidelines define early surgery for IE as being within the initial hospitalization but before completion of the full course of antibiotics.\textsuperscript{1–2} In some cases, patients who meet criteria for early surgery may benefit from a delay, such as in the case of a hemorrhagic stroke.\textsuperscript{5,22} A delay of at least 4 weeks should be considered for stable patients with intracerebral hemorrhage to minimize the risk of worsening the hemorrhage with heparinization and CPB.\textsuperscript{27–29} Overall, early surgery should be considered for those who meet the listed criteria, but the timing should be individualized based on the risks and benefits to each patient.

This case conference has presented complex right- and left-sided IE with the features of abscess and fistula in the setting of 2 congenital heart defects, a restrictive VSD, and a bicuspid aortic valve. Expert comprehensive TEE has a central role.
in guiding anesthetic and surgical management of these challenging cases. The following 2 expert commentaries further highlight the salient features of this noteworthy case.

**Commentary 1**

The authors present a case of complex IE, which can be a devastating disease with an in-hospital mortality rate of 20%. As many as 50% of IE patients will require surgical intervention due to persistent bacteremia, emboli, or heart failure. Heart failure due to valve dysfunction is the most common indication for surgery; however, the timing of surgical intervention is challenging and differs between major European and US guidelines. In the present patient, factors identified on preoperative imaging necessitating early surgical intervention were vegetation size and recurrent septic emboli. Ultimately, the aortoventricular fistula, which also is an indication for prompt surgery, was detected with the intraoperative TEE examination.

In the present patient, the initial preoperative TTE examination was not diagnostic for IE. The negative predictive value of TTE is >90% and can be improved to 97.1% using strict criteria for a negative examination. TTE remains a powerful and noninvasive screening tool, with TEE reserved for use in those with poor acoustic windows or questionable TTE findings. In the present patient, repeat TTE was performed due to the high-risk clinical picture and was significant for aortic valve, mitral valve, and right ventricular vegetations.

Intraoperative TEE examination is recommended by professional societies for all IE cases as a mandatory step to assess for progression from preoperative imaging and to define overall disease burden to aid in the surgical planning. In addition to assessment of valve suitability for repair versus replacement, local complications such as abscess, fistula, or pseudoaneurysm also must be identified. Perivalvular extension of IE is common, occurring in up to 40% of cases. Perivalvular abscess, fistula, and/or pseudoaneurysm must be resected and repaired by the surgeon at the time of the initial surgery because antibiotic therapy alone will not

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cure complex IE. Failure to do so will result in continued infection or IE recurrence. Comprehensive TEE was used in the present patient to identify a fistula between the aorta and right ventricular outflow tract that was not identified on preoperative imaging. In the absence of a detailed intraoperative TEE examination, this complex IE complication would have gone unidentified, resulting in persistent IE and deleterious outcome.

The discovery of the aortocardiac fistula serves to remind the perioperative physician of the importance of a complete, structured TEE examination. A systematic TEE examination for all cardiac cases, including IE, will afford the perioperative echocardiographer the learning milieu for practice; repetition; and, ultimately, pattern recognition in order to identify subtle abnormal intraoperative findings correctly and in a timely fashion.

Presumably, the patient in the presented case was misdiagnosed with pneumonia as the causative reason for her fevers, dyspnea, fatigue, and pleuritic chest pain. The underlying causative disease state likely was IE with symptoms secondary to septic emboli from her right-heart vegetations. At the time of IE diagnosis, the patient already had experienced numerous advanced IE complications, including heart failure and septic emboli causing acute renal failure, ST-elevation myocardial infarction, pulmonary hypertension, and pneumonia. The patient demonstrated a well-known major risk factor for IE: intravenous drug abuse. However, a less well-known, but major, risk factor for IE also was present: a history of congenital heart disease. The incidence of IE in adults with congenital heart disease is increased compared with that of the general population, representing approximately 5.5% of all IE cases. Furthermore, VSD has been identified as a leading congenital abnormality associated with IE. As in the present case, 40% of IE cases in those with congenital abnormalities develop right heart infective lesions. Septic emboli from the right-heart vegetations likely were the underlying cause of the patient’s multifocal pneumonia that also contributed to her pulmonary hypertension. It remains plausible that a high index of suspicion in a patient with a history of intravenous drug abuse and congenital VSD displaying fevers, dyspnea, and fatigue may have led to more timely diagnosis and management of IE. Earlier diagnosis may have arrested further disease progression to complex IE with heart failure, abscess, fistula formation, and septic emboli.
Commentary 2

This case conference discusses an interesting and challenging case of a young woman with multifocal IE involving the bicuspid aortic valve, mitral valve, and a right-sided mural component of a perimembranous VSD. During the performance of the TEE examination before CPB, the authors noted a high-velocity jet emanating from the aorta to the right ventricular outflow tract that also was confirmed on surgical inspection to be a fistulous connection between the aortic root and the right ventricular outflow tract. The authors should be commended for their performance of this high-quality echocardiographic examination and discovery of a new significant finding. Their findings of this significant fistula led to a modification of the original surgical plan and the possible prevention of a second cardiac procedure.

The modification of the cardiac surgical plans is illustrative of the issues related to the perioperative management of IE. Echocardiography is the mainstay of diagnostic imaging in IE, with TEE superior to TTE for detection of findings and complications of IE (Table 2), as in the presented patient. Moreover, TEE should be performed in all cases of aortic valve IE. The European Society of Cardiology recommends intraoperative TEE be performed in all patients needing surgical intervention for IE.

As the authors indicate, it is incumbent on the cardiac anesthesiologist to understand the multitude of ways that IE may affect cardiac structures, with fistula formation as an example and discussed in more detail later. As with any infective process, IE may colonize, infect, and ultimately destroy any given cardiac structure. The vegetations associated with IE are collections of bacteria, fibrin, and platelets that typically are associated with valve closure lines. Valvular vegetations, which may be single or multiple, typically occur on the atrial surface of the atriocentral valves and the ventricular surface of the pulmonary and aortic valves, but may involve any endocardial surface or implanted material. Valvular extension may involve the endocardium, subvalvular apparatus, the proximal pulmonary artery, and ascending aorta. Perivalvular extension is common for both native (10%-40%) and prosthetic (56%-100%) valve endocarditis. Valvular infection may extend to involve cardiac structures discontinuous from the infected valve, including myocardial infection in atypical tissue planes. When patients present for surgery related to valvular vegetations, the TEE examination before CPB should be comprehensive and meticulously conducted to evaluate for sequelae due to IE that may have been missed during preoperative imaging or that could have developed in the interval between the preoperative study and surgical intervention (see Table 2).

The reported intraoperative discovery of the aortocavitary fistula highlights an uncommon and serious complication of IE and further emphasizes the importance of the TEE examination before CPB. In this complex case, the patient’s aortic valve IE was a risk factor for periaortic abscess formation that can rupture internally, leading to the development of aortocavitary fistulae. Such fistulae are rare and most reports involve single cases, which makes understanding the true incidence of such events difficult. Most cases of such fistulae in the literature occur after surgical trauma during open valve replacement, transcatheter aortic valve replacement, aortic dissection, or trauma to the chest; they only rarely occur after IE.

The fistulous tract described by the case authors was possibly due to the small area of anatomic overlap between the aorta and the right ventricular outflow tract (see Figs 4 and 5). Cases have been reported of aorta-to-left ventricular outflow tract fistula, aortic root-to-left atrium fistula, sinus of Valsalva-to-right atrial fistula, right coronary artery-to-suprior vena cava fistula, and complex fistulae from aorta to multiple cardiac chambers. In most IE-related fistulae, the spread of infection to the perivalvular tissue occurs with aortic valve involvement. These aortic root complications can involve aortic abscess or erosion of aortic root. They can rupture internally with the development of an aortocavitory fistula. The pathophysiology of fistulous tract formation requires extension of the infection through the aortic wall, which leads to the creation of an abscess cavity. Then, if annular destruction persists, a fistula may develop.

The role of pathogen virulence of the organism causing the IE and its effect on the development of fistulae is unresolved. S. aureus has been identified as a common cause of aortocavitary fistulae in many reports. A recent review examined a series of 39 fistulae that were stratified into either congenital (47%) or acquired (53%). In that report, fistulization was an uncommon complication of aortic valve IE and was associated with high morbidity and mortality. A retrospective report of 4,681 IE cases found 76 patients with aortocavitary fistula. In that study, fistula formation was prevalent in aortic valve IE and was more frequent in prosthetic than in native aortic valve endocarditis (5.8 v 3.6%, p = 0.04).

Echocardiography is the imaging modality of choice to assess the presence and extent of a fistula associated with IE accurately. Echocardiography has matured as a diagnostic tool to help in the understanding of fistula characteristics, with TEE in particular being the preferred imaging technique. The fistula then can be further evaluated using cardiac catheterization and aortography to confirm the diagnosis. Computed tomography and cardiac magnetic resonance imaging are not as widely applied diagnostic modalities but have been used in this context as well. The complication rate of IE-related fistulae is high, with more than 60% of patients developing significant heart failure and an associated mortality risk exceeding 40%. Furthermore, in this patient, significant heart failure rather than aortic regurgitation was an independent risk factor for death.

The treatment of choice for complex fistulae remains early surgical repair to prevent the development of complications. The closure of these types of fistula has been achieved with an array of surgical techniques, such as simple closure, pericardial patches, and prosthetic patches. Concomitant valve replacement frequently is required in a large percentage of these.
Table 2
Cardiac Findings and Complications of IE

<table>
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<tr>
<th>Findings/Complications</th>
<th>Comments</th>
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| Vegetation*            | ● Whole vegetations or fragments may embolize to any vascular bed (septic emboli)  
                         ○ For left-sided lesions: brain and spleen are most common  
                         ○ For right-sided/CIED-based lesions: pulmonary  
                         ○ Size (> 10 mm), mobility, and mitral-based lesions are robust predictors of embolism  
                         ○ Embolism risk highest during beginning of antibiotic therapy |
| Leaflet perforation    | ● Most common is anterior mitral valve leaflet as a secondary complication of aortic valve IE (“jet lesion”)  
                         ● Occlusion of aortic valve by vegetation |
| Chordae rupture        | Possible in severe infection |
| Papillary muscle rupture | Possible in severe infection |
| Atrial/ventricular septal perforation | Possible in severe infection |
| Abscess (perivalvular, periaortic, myocardial)* | ● Aortic and prosthetic valve IE most frequent association  
                                                  ● Early or small abscess detection is difficult especially when visualization is hampered by calcification or nonbiologic material  
                                                  ● Commonly involves aortomitral curtain and prosthetic valves  
                                                  ● May lead to fistulization or pseudoaneurysm |
| Valve aneurysm         | Possible in severe infection |
| Mycotic aneurysm       | Associated with septic emboli |
| Pseudoaneurysm (communicates with heart chamber/vessel lumen) | Complication of abscess formation |
| Fistulization          | Complication of abscess formation |
| Prosthetic valve dehiscence* | ● Lower incidence of vegetations but higher likelihood of abscess formation and perivalvular complications  
                                             ● IE should be suspected with any new paravalvular leak  
                                             ● Associated with tricuspid or mitral valve infection, proximal aorta pseudoaneurysm, myocardial abscess |
| Pericarditis           | |

Abbreviation: CIED, cardiac implanted electronic device; IE, infective endocarditis.
*Major echocardiographic criteria for IE.

patients. Percutaneous closure has been described and is considered to be a safe alternative in select cases.46,47

Another important facet of the presented case is the interplay between IE and heart failure. Significant heart failure is 1 of the 3 most common and significant complications of IE along with perivalvular extension of infection and embolic complications.27–29 Heart failure is not only a common indication for prompt surgical intervention in IE but also is an independent predictor for significant mortality and morbidity.1,2,25,26 Acute heart failure also may be related to direct valve destruction, causing a new severe regurgitation or a new obstructing lesion. Surgery for IE is less urgent in mild heart failure, especially if an appropriate response to antibiotic therapy allows for the clearance of infection. However, mild heart failure may worsen significantly if valvular dysfunction progresses and/or chronic infection persists.3–5

In native valve IE, new severe valvular regurgitation may be caused by a perforation or chordae/papillary muscle involvement leading to valve prolapse or a flail leaflet.16–18 Conversely, large mobile vegetations may lead to acute heart failure as a consequence of functional valve obstruction.20–22 In native valve IE, acute valvular regurgitation is the most common lesion causing new-onset heart failure. Prosthetic valve endocarditis also may lead to new severe regurgitation or prosthetic obstruction with resultant heart failure.3–5 Prosthetic valve IE with mechanical valves has a predilection for the sewing ring/annulus interface and extension of infection with resultant dehiscence, perivalvular abscess, and fistulization.13,14 Bioprosthetic valve IE typically affects the leaflets, causing perforation, rupture, and vegetation formation.3–5,13,14 Echocardiography is mandatory when heart failure develops in the context of IE to delineate the exact mechanism. Heart failure also may be due to myocarditis, myocardial infarction, and pericarditis. Myocardial infarction may be caused by a variety of reasons related to IE, including coronary obstruction from septic emboli, an aortic valve vegetation leading to ostial occlusion, and abscess-engendered coronary compression.1,2,25,26

In summary, the presented case elucidates a number of the key echocardiographic and perioperative issues for the cardiac anesthesiologist caring for a patient with IE presenting for surgery. The patient requiring IE-related cardiac surgery requires a disciplined and comprehensive TEE examination before CPB, with a focus on corroborating the preoperative echocardiographic findings and seeking out additional IE-related cardiac complications.

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