Endocarditis: the complementary roles of CT and echocardiography

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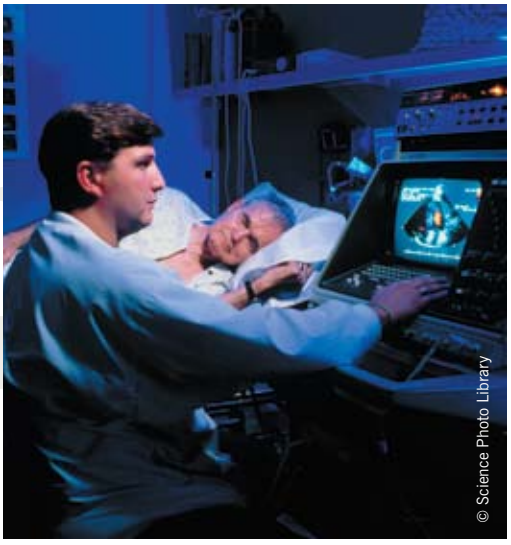
In-hospital mortality from infective endocarditis remains high, ranging from 9.6 to 26%, and relates to many factors including associated co-morbidities (including previous valve replacement), the complications of endocarditis present, the micro-organism involved, and a number of echocardiographic features.[1] Currently, echocardiography remains the mainstay of imaging for diagnosis and evaluation of complications, monitoring of response to therapy, intra-operative evaluation (where relevant), and follow-up.[1,2] Indeed, three echocardiographic features are considered major criteria in the diagnosis: vegetation, abscess and new dehiscence of a prosthetic valve. Although the limitations of echocardiography are well recognised, the use of other imaging modalities for evaluation of endocarditis remains limited. Indeed, 2009 European Society of Cardiology (ESC) guidelines state that "Other advances in imaging technology have had minimal impact in routine clinical practice … alternative modes of imaging (computed tomography [CT], magnetic resonance imaging [MRI], positron emission tomography [PET], and radionuclide scanning) have yet to be evaluated in infective endocarditis".[1]

The case study in this issue (**see pages 46–7**) demonstrates a potential use of CT scanning in the diagnosis of a patient with endocarditis. Electrocardiogram (ECG)-gated multi-detector cardiac computed tomography (MDCT) scanning has been proposed by many to have potential in the evaluation of endocarditis by demonstration of vegetations, complications (coronary artery occlusion, fistulae) and peripheral embolism.[3] The major limitations of the technique include availability, spatial resolution, failure to demonstrate leaflet perforations and lack of haemodynamic information (**table 1**). Further, CT findings have not been correlated with clinical outcomes, and radiation dosage may preclude its use for the repeated studies required for monitoring response to therapy and for follow-up. The main strengths of the technique may, however, lie in specific clinical circumstances, outlined below.



Evaluation of prosthetic valve endocarditis (PVE)

The sensitivity of transthoracic echocardiography (TTE) in PVE is relatively poor, and although transoesophageal echocardiography (TOE) is mandated in patients with suspected PVE, its diagnostic value is less than in native valve endocarditis.[1,2] MDCT is potentially superior in demonstration of prosthetic valve malfunction due to pannus and/or thrombus (in particular where multiple valve replacements are present), and may be superior in demonstration of paraprosthetic complications and vegetations.[3,4]

Patients scheduled for surgery

The risks of undertaking conventional coronary angiography in patients with aortic valve endocarditis include potentially fatal embolisation during catheter manipulation. Assessment using multi-slice CT allows non-invasive coronary artery imaging, has been shown to reliably exclude significant coronary artery stenosis, demonstrate localisation and course of coronary arteries with respect to aneurysms/masses, and may be useful in patients judged to be at high risk of embolisation due to the size and/or position of their vegetations.[4,5] Further, superior

visualisation by CT of the perivalvular extension (including myocardial, pericardial and coronary sinus involvement) and three-dimensional reconstruction of peri-annular tissue destruction/perivalvular pseudoaneurysm have been proposed as an aid for pre-surgical planning in complex cases of endocarditis.[4]

Negative echocardiography but high index of suspicion: enhanced imaging

Combined PET and CT with 18-F-flourodeoxyglucose has been shown to have a high sensitivity for endocarditis in one small study.[6] Further, an additional report suggested this technique could confirm suspected endocarditis where echocardiography had been negative, simultaneously excluding a potential extra-cardiac source of infection.[7] In another case study, a patient with previous aortic valve replacement with a permanent pacing system underwent echocardiography and standard CT with no identification of infective focus. Here, gallium single-photon emission CT (^{67}Ga-SPECT) imaging helped to correctly identify the prosthetic aortic value as the source of sepsis, and demonstrate resolution of changes on subsequent imaging.[8]

Evaluation of embolic complications

Case reports and small series have suggested that the main advantage of CT over echocardiography may be in the demonstration of systemic and pulmonary embolisation.[9,10] Reported central nervous system complications of endocarditis range from 20–40%, and CT scanning may be used to localise mycotic aneurysms, demonstrate haematoma, haemorrhage and cerebral abscesses. Due to limits of the technique, CT is not adequate for the diagnosis of cerebritis, microabscesses, or microinfarcts. Where suspected, MRI may be indicated.[11]

Thus, although this case report highlights the potential use of CT scanning in the diagnosis of endocarditis, its routine use is not currently recommended. Under certain circumstances, expertly performed and interpreted CT scanning may potentially be of value in answering specific questions, and as a complementary imaging technique to echocardiography, however, widespread application should be considered with caution

Table 1. Strengths and weaknesses of echocardiography and CT for evaluation of endocarditis (for references, see text)

	TOE	CT
Vegetations and perforations	• Excellent spatial and temporal resolution • Challenging imaging in PVE • Demonstration of leaflet perforation in aortic valve endocarditis challenging	• May miss vegetations <4 mm • Possible superior performance in demonstration of prosthetic vegetations • Probable inferior performance in demonstration of leaflet perforations
Haemodynamic effects	• Well-validated technique for evaluation of haemodynamics, however; • May be difficult to assess when very severe acute lesions present	• Limited predominantly to planimetry
Abscess cavities	• Highly operator dependent • Challenging in early endocarditis • Emerging data suggests possibly CT superior	• Excellent visualisation of abscesses, aneurysms and pseudoaneurysms • Able to image whole of thorax • Combination with PET may assist in diagnoses of root abscesses
Fistulae/abnormal connections	• Highly operator dependent but well demonstrated	• Excellent visualisation
Coronary artery involvement	• Delineation of proximal coronary artery segments generally possible • RCA may be difficult to image in the presence of AVR • Anomalous coronary arteries in the presence of an enlarged aortic root may be difficult to image • Inadequate for demonstration of anything other than ostial coronary artery stenosis • Myocardial infarction and/or ischaemia may be suggested by new RWMA	• Excellent demonstration of coronary arteries with respect to cardiac anatomy • Potential avoidance of pre-operative cardiac catheterisation in high-risk cases
Extra-cardiac 'endocarditis' and peripheral embolisation	• Intra-cardiac and ascending aorta (including previous cannulation sites) well visualised • Peripheral embolisation not visualised • Extra-cardiac shunts challenging	• Well documented with respect to embolisation (neurological, pulmonary and systemic) and abscess formation • 'Extra-cardiac' endocarditis (including extra-cardiac shunts) well visualised but need additional imaging techniques to demonstrate infection

Key: AVR = aortic valve replacement; PET = positron emission tomography; PVE = prosthetic valve endocarditis; RCA = right coronary artery; RWMA = regional wall motion abnormality; TOE = transoesophageal echocardiography

Conflict of interest

SP has an educational contract with Medtronic

Editors' note

See also the Case Report by Howe and Purvis on pages 46–7 of this issue.

References

1. Habib G, Hoen B, Tornos P *et al.*; Task Force on the Prevention, Diagnosis, and Treatment of Infective Endocarditis of the European Society of Cardiology (ESC). Guidelines on the prevention, diagnosis, and treatment of infective endocarditis. *Eur Heart J* 2009;**30**:2369–413. http://dx.doi.org/10.1093/eurheartj/ehp285

2. Habib G, Badano L, Tribouilloy C *et al*. Recommendations for the practice of echocardiography in endocarditis. *Eur J Cardiol* 2010;**11**:202–09.

3. Konen E, Goitein O, Fienberg M *et al.* The role of ECG-gated MDCT in the evaluation of aortic and mitral mechanical valves: initial experience. *AJR Am J Roentgenol* 2008;**191**:26–31. http://dx.doi.org/10.2214/AJR.07.2951

4. Feuchtner GM, Stolzman P, Dichtl W *et al.* Multislice computed tomography in infective endocarditis: comparison with transesophageal echocardiography and intraoperative findings. *J Am Coll Cardiol* 2009;**53**:436–44. http://dx.doi.org/10.1016/j.jacc.2008.01.077

5. Lentini S, Monaco F, Tancredi F *et al.* Aortic valve infective endocarditis: could multi-detector CT scan be proposed for routine screening of concomitant coronary artery disease before surgery? *Ann Thorac Surg* 2009;**87**:1585–7. http://dx.doi.org/10.1016/j.athoracsur.2008.09.015

6. De Winter F, Vogelaers D, Gemmel F, Dierckx RA. Promising role of 18-F-Flouro-D-deoxyglucose positron emission tomography in clinical infectious diseases. *Eur J Clin Microbiol Infect Dis* 2002;**21**:247–57. http://dx.doi.org/10.1007/s10096-002-0708-2

7. Vind S, Hess S. Possible role of PET/CT in endocarditis. *J Nuclear Cardiol* 2009;**17**:516–19. http://dx.doi.org/10.1007/s12350-009-9174-x

8. Yavari A, Ayoub T, Lefteris L *et al.* Diagnosis of prosthetic aortic valve endocarditis with gallium-67 citrate single-photon emission computed tomography/computed tomography hybrid imaging using software registration. *Circ Cardiovasc Imaging* 2009;**2**:e41–e43. http://dx.doi.org/10.1161/CIRCIMAGING.109.854661

9. Fellah L, Waignein F, Wittebole X, Coche E. Combined assessment of tricuspid valve endocarditis and pulmonary septic embolism with ECG-gated 40-MDCT of the whole chest. *AJR Am J Roentgenol* 2007;**189**:W228–W230. http://dx.doi.org/10.2214/AJR.05.1021

10. Royden Jones H, Siekert R. Neurological manifestations of infective endocarditis: review of clinical and therapeutic challenges. *Brain* 1989;**112**:1295–315. http://dx.doi.org/10.1093/brain/112.5.1295

11. Bertorini TE, Laster RE, Thompson BF *et al*. Magnetic resonance imaging of the brain in bacterial endocarditis. *Arch Intern Med* 1989;**149**:815–17. http://dx.doi.org/10.1001/archinte.149.4.815

News

Primary Care Cardiovascular Society announces closure

The *British Journal of Cardiology* is sorry to report the closure of the Primary Care Cardiovascular Society (PCCS), which ceased operating at on the 31st of January 2012. The BJC has been the society's official journal.

The Society was closed following an Extraordinary General Meeting of the PCCS where there was a unanimous vote in favour of the motion 'To approve the proposed voluntary winding up of the PCCS, its dissolution and removal from the Central Register of Charities'.

A statement released by the PCCS says "Since the PCCS was established 15 years ago, it has relied heavily on the pharmaceutical industry to support its educational activities. The recession and patent expiries have had a significant impact on the pharmaceutical industry and the availability of funds for all activities, including the PCCS. This situation is likely to deteriorate rather than improve for the foreseeable future. As the funding model for the PCCS is largely based on income from the industry, its future could not be guaranteed. Although the PCCS is currently solvent, looking forward, with the changes within the major funding sources, remaining solvent would be a challenge.

"The PCCS has been well managed and all financial matters are in order with a small surplus of funds. Once the winding up procedure is completed, the remaining balance will be gifted to a likeminded national Cardiovascular Charity".

Chief Executive and Founder Member of the PCCS Dr Fran Sivers said: "This is a very sad time for all who have been involved with the Society and the closure of the PCCS will leave a major gap in primary care cardiology".

BJC Editor Dr Henry Purcell said: "We have enjoyed a good working relationship with the PCCS through the years and we are sorry to see the Society close. We will miss the enormous contribution it has made to primary care cardiology. The BJC continues to support primare care cardiology – since the journal's inception, we have recognised the contribution made to cardiovascular medicine by primary care in the UK and we will continue to fully cover and report on its important developments and achievements."