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**Echo for Risk Stratification:
 Who Really Deserve Early Surgery?
 What's the Evidence?**


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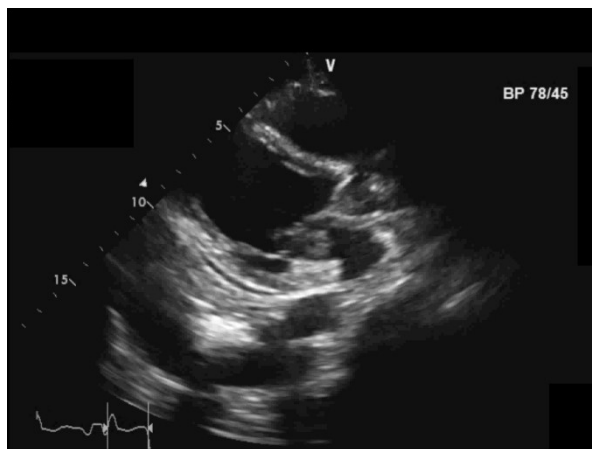
66 years old female

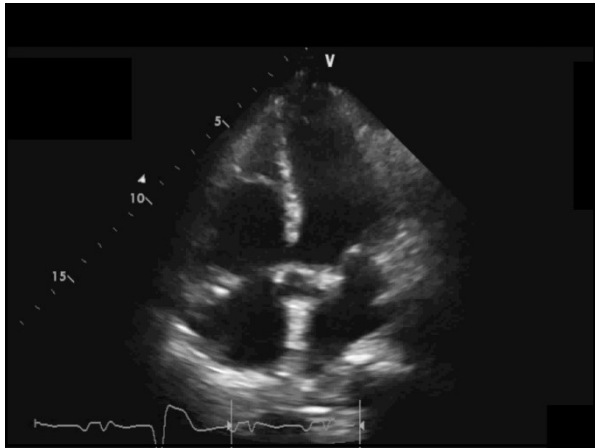
Presenting complaint:
 AMS x3/7
 - noted by family to be confused and drowsy
 - no fever, CP/SOB,

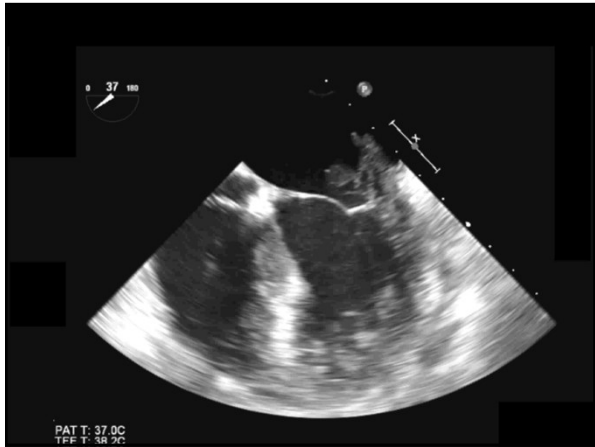


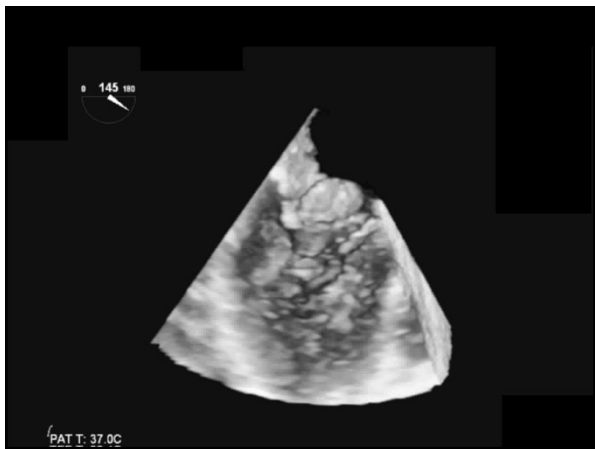
O/E:
 Drowsy, hypoactive delirious, poor attention span
 Pale ++
 Osler nodes and Janeway lesions seen in all 4 extremities

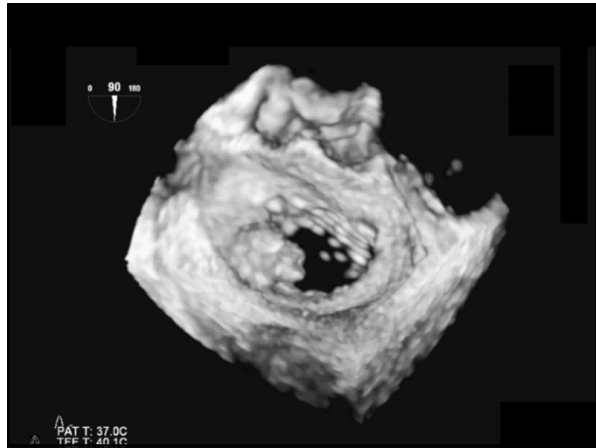
Bedside echocardiography
 Chen M, et al. ACC/AHA/AHA 2003 guideline update for the clinical application of echocardiography. *J Am Coll Cardiol* 2003;42:954-970.

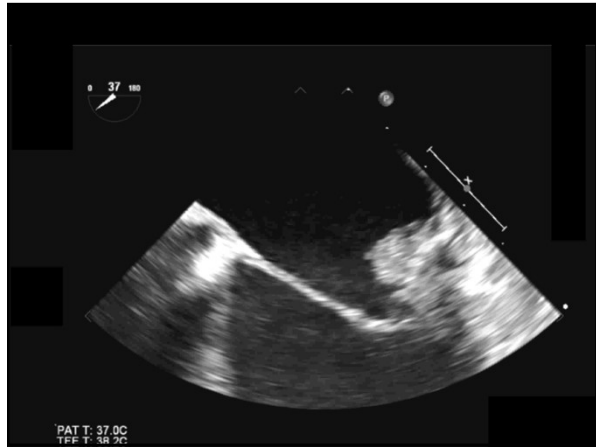


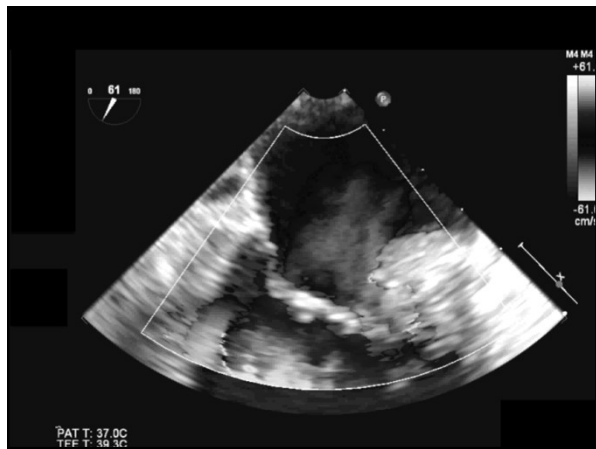












MV endocarditis with **leaflet perforation & annulus/myocardium abscess**

Bacteremia & ongoing **embolization** (CNS involvement)

AKI & possibly DIC

Blood culture - MSSA

Started on IV cloxacillin, ampicillin and gentamicin on admission

- currently on IV cloxacillin as per ID

- S/b CTVS: offered high risk open heart surgery

Cheitlin MD et al. ACC/AHA/AASE 2003 guideline update for the clinical application of echocardiography J Am Coll Cardiol 2003;42:954-970.

Case 2: 54 yr old, male, with history of diabetes mellitus

Admitted for:

- chest discomfort – assoc with palpitations and diaphoresis
- loss of weight ~ 10kg over 1.5 months
- cough 2-3 weeks
- lower limb edema X 3 days

O/E:

Alert, Afebrile

BP: 95/55 mmHg, HR: 99 bpm, AF

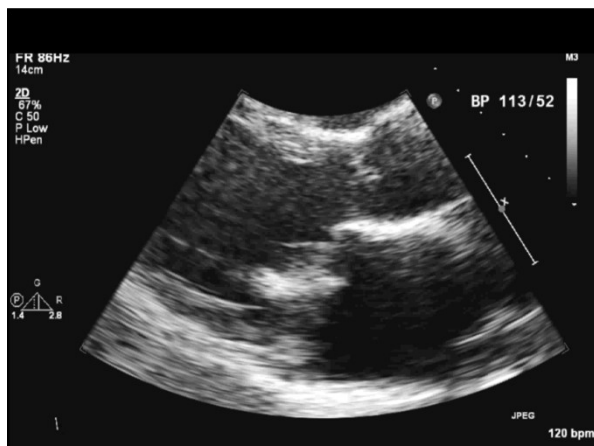
Bilateral hand clubbing

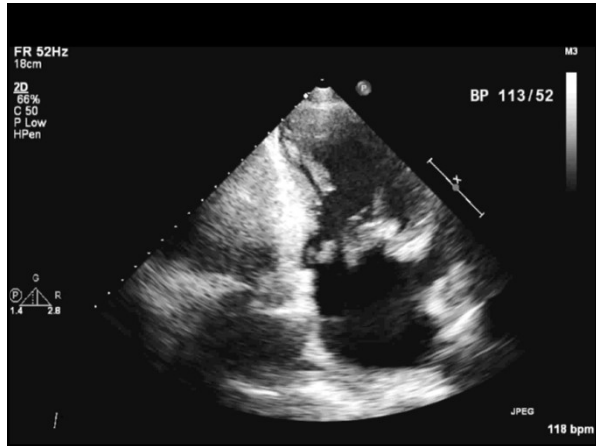
H: S1S2, pansystolic murmur

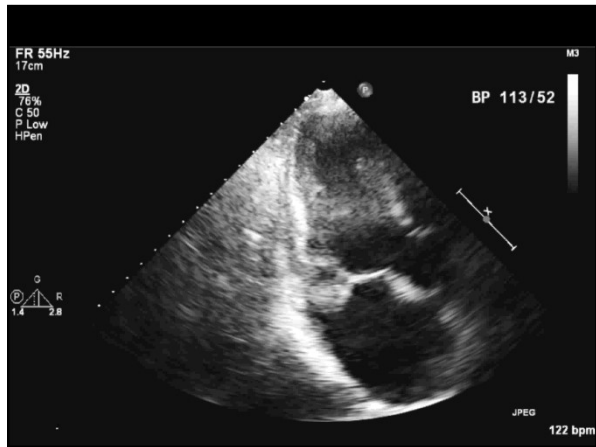
L: bibasal crepitation

Pitting lower limb edema

Cheitlin MD et al. ACC/AHA/AASE 2003 guideline update for the clinical application of







Troponin –elevated – ? NSTEMI + CCF -
 Coronary angiography – Normal

Blood cultures negative

CT TAP – splenic infarcts and together with AF –
 anticoagulation

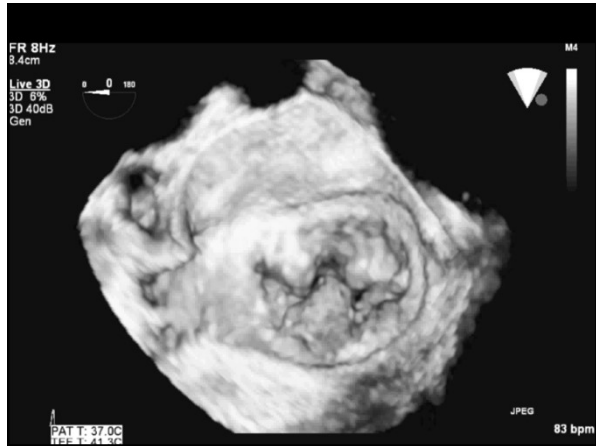
Home with TEE appointment in 4 days

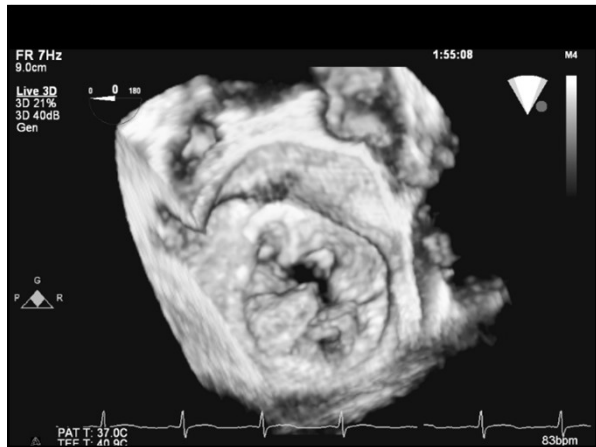
Revisited hx :
 Intermittent night fever x 2/52 prior to previous
 admission with cough – given antibiotics for 2/7
 still having malaise post discharge











Multiple large vegetations (22x19 mm) predominantly involving the P2 and P3 scallops of the posterior mitral leaflet with **destruction** of the valve and **perforation** of the P3 scallop, leading to **severe mitral regurgitation**.
 Regurgitant volume by simplified PISA method was 71 mls.
 Anterior mitral valve leaflet is thickened and prolapsed.
 No perivalvular abscess.
 Systolic reversal seen in 2/4 of pulmonary veins

Cheitlin MD et al. ACC/AHA/ASE 2003 guideline update for the clinical application of echocardiography *J Am Coll Cardiol* 2003;42:954-970.

Blood culture and for prolonged incubation

Intravenous broad spectrum antibiotics

Blood culture - GPC – Gomella Sanguinis

Underwent – MIS MV Replacement (Medtronic Mosaic Porcine 33mm)

Cheitlin MD et al. ACC/AHA/ASE 2003 guideline update for the clinical application of echocardiography *J Am Coll Cardiol* 2003;42:954–970.

Left sided valve infective endocarditis

- Surgical treatment required in ≈ 50% IE due to severe Cx.
- Early surgery (i.e. while on Abx)
 - avoid progressive HF and irreversible damage.
 - prevent systemic embolism.
- However, early surgery → significant risk !

High-risk features →
cure with antibiotic
treatment unlikely

Comorbidities/Cx →
recovery from
surgery unlikely



Habib G et al. *European Heart Journal* (2015) 36, 3075–3123.

Left sided valve infective endocarditis

- Need for early surgery determined by a combination of high-risk features
- emergency (within 24 hr) irrespective of
- urgent (< 7 days)) Abx duration
- surgery postponed to allow 1 or 2 weeks of antibiotic treatment under careful clinical and echocardiographic observation
- 3 main indications for early surgery in IE are
 - HF
 - uncontrolled infection
 - prevention of embolic events

Heart Failure

- Identification of surgical candidates and timing of surgery decisions shd be made by the Endocarditis Team.
- HF → principal indication for urgent surgery.
- Usu caused by severe aortic or mitral regurgitation, intracardiac fistulae or valve obstruction caused by vegetations.
- Surgery: also indicated in severe acute AR or MR without HF but with echocardiographic signs of
 - ↑ LVEDP (e.g. premature closure of the mitral valve)
 - left atrial pressure
 - moderate to severe pulmonary hypertension
 - large vegetation

Habib G et al. *European Heart Journal* (2015) 36, 3075–3123.

Heart Failure

- NYHA I or II – severe valvular regurgitation and no other reasons for surgery → medical management with antibiotics under strict clinical & echo observation
- Elective surgery should be considered depending on the tolerance of the valve lesion
- HF → most frequent and among the most severe complication
- Unless severe co-morbidity exists, the presence of HF is an indication for early surgery in NVE and PVE, even in patients with cardiogenic shock.

Thuny F, et al. The timing of surgery influences mortality and morbidity in adults with severe complicated infective endocarditis: a propensity analysis. *Eur Heart J* 2011;32: 2027–2033

Heart Failure

- **Echo:** crucial for initial evaluation and FU
 - valve perforation,
 - secondary lesions (eg mitral fr aortic IE) and aneurysms
- **Echocardiography** useful to:
 - evaluate haemodynamic conseq of valvular dysfunction,
 - measurement of PASP,
 - detection of pericardial effusion,
 - assessment and monitoring of LV systolic function and left and right heart filling pressures

Habib G et al. *European Heart Journal* (2015) 36, 3075–3123.

Uncontrolled infection

- One of the most feared complication and 2nd more frequent reason of surgery
- **Persistent infection**
 - Fever &) after 7–10 days
 - persisting positive cultures) of antibiotics
- Persisting fever: inadequate antibiotic therapy, resistant organisms, infected lines, locally uncontrolled infection, embolic complications or extracardiac site of infection and adverse reaction to antibiotics.
- **Perivalvular extension**
 - a/w poor prognosis and high likelihood of the need for surgery.
 - include abscess formation, pseudoaneurysms and fistulae

Uncontrolled infection

- Despite high rates of surgery in this population (87%), hospital mortality remains high (41%).
- Other complications due to major extension of infection are less frequent and may include VSD, 3rd deg AVB, ACS
- **Perivalvular extension** should be suspected in cases with persistent unexplained fever or new AVB.
- ECG should be performed frequently esp in aortic IE.
- TEE, MSCT and PET/CT are particularly useful for the diagnosis of perivalvular complications

Indications and timing of surgery in the presence of uncontrolled infection in IE

- **Persistent infection**
 - Antibiotics alone are insufficient to eradicate the infection.
 - Surgery indicated - fever and +ve blood cultures persist for several days (7–10 days) despite appropriate antibiotic regimen and when extracardiac abscesses (splenic, vertebral, cerebral or renal) and other causes of fever have been excluded.
- Best timing for surgery in this difficult situation is unclear.

Lalani T, et al. In-hospital and 1-year mortality in patients undergoing early surgery for prosthetic valve endocarditis. JAMA Intern Med 2013;173:1495–1504

Locally uncontrolled infection

- Signs of locally uncontrolled infection include
 - increasing vegetation size,
 - abscess formation,
 - false aneurysms, &
 - new fistulae.
- Persistent fever usually present and surgery is as soon as possible.

Infection by microorganisms at low likelihood of being controlled by antimicrobial therapy

- Surgery is indicated in
 - fungal IE
 - multiresistant organisms (e.g. MRSA or vancomycin-resistant enterococci)
 - rare infections caused by Gram -ve bacteria
 - PVE caused by staphylococci or non-HACEK gram -ve bacteria.
 - NVE caused by *S. aureus*, where favourable early response to antibiotics is not achieved

Emboic events in IE

- Frequent and life-threatening
- Left-sided IE → brain and spleen
- Native right-sided and pacemaker lead IE → pulmonary

Predicting risks of embolism in IE

- **Echo:** key role in predicting embolic events
- Increased risk of embolism
 - size and mobility of vegetations ***
 - location of the vegetation (mitral valve)
 - the increasing or decreasing vegetation size under antibiotic therapy
 - particular microorganisms (*S. aureus*, *S. bovis*, *Candida*)
 - previous embolism
 - multivalvular IE
- >10mm, >15mm, >30mm in length are at higher risk of embolism

Tischler MD, et al. The ability of vegetation size on echocardiography to predict clinical complications: a meta-analysis. *J Am Soc Echocardiogr* 1997;10: 562–568.

Predicting risks of embolism in IE

- Study of 847 IE, the 6-month incidence of new embolism was 8.5%
- 6 factors (age, diabetes, AF, previous embolism, vegetation length and *S. aureus* infection) → ‘embolic risk calculator’
- Risk of new embolism is highest during the first days following initiation of antibiotic therapy and rapidly decreases thereafter, particularly beyond 2 weeks
- The benefits of surgery to prevent embolism are greatest during 1st 2/52 of antibiotic therapy

J Am Coll Cardiol 2013;62:1384–1392.

Indications and timing of surgery to prevent embolism in IE

- Avoiding embolic events difficult: majority occur before admission
- The best means to reduce the risk of an embolic event → prompt institution of appropriate antibiotic therapy.
- Addition of antiplatelet therapy did not reduce the risk of embolism (evidence: RCT)

Chan KL, et al. A randomized trial of aspirin on the risk of embolic events in patients with infective endocarditis. *J Am Coll Cardiol* 2003;42:775–780.

Indications and timing of surgery to prevent embolism in IE

- Early surgery in preventing embolic events: controversial.
- Randomized trial → early surgery for large vegetations significantly reduced the risk of death and embolic events compared with conventional therapy.
- However, patients were at low risk and there was no significant difference in all-cause mortality at 6 months in the early surgery and conventional-treatment groups.
- Decision to operate early for prevention of embolism must consider the presence of previous embolic events, other IE complications, the size and mobility of the vegetation, the likelihood of conservative surgery and the duration of antibiotic therapy.

Indications and timing of surgery to prevent embolism in IE

- Surgery is indicated in patients with persisting vegetations >10 mm after embolic events despite appropriate antibiotic treatment.
- Surgery may be considered in large (>15 mm) isolated vegetations on the aortic or mitral valve (decision is more difficult and must be very carefully individualized)
- Surgery must be performed very early, during the first few days following initiation of antibiotic therapy (urgent surgery), as the risk of embolism is highest at this time.

Other complications of IE

- Neurological complications
 - Randomized studies are not possible and cohort studies suffer from bias that can only be partly compensated for by statistical methods.
 - Evidence regarding the optimal time interval between stroke and cardiac surgery is conflicting, but recent data favour early surgery
 - Surgery should generally be postponed for at least 1 month in ICH
- Infectious aneurysms
 - ruptured aneurysms must be treated immediately by surgical or endovascular procedures
- Splenic complications
- Myocarditis and pericarditis
- Heart rhythm and conduction disturbances
- MSK symptoms
- ARF

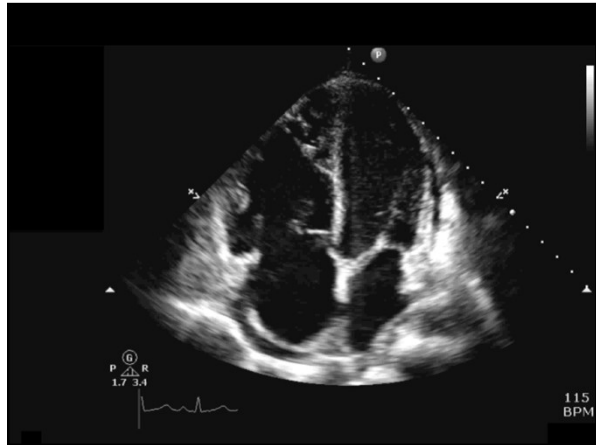
24 years old female

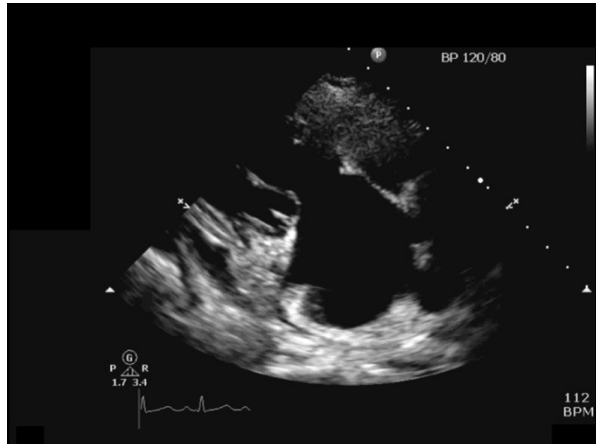
h/o i) polyarthritis
ii) iron deficiency anemia
iii) previous Subutex abuse

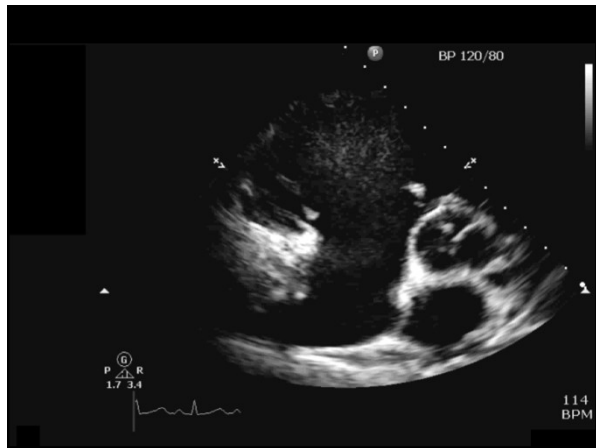
Admitted for:
Infective endocarditis – *Stap hominis* bacteremia
septic emboli – lung abscess

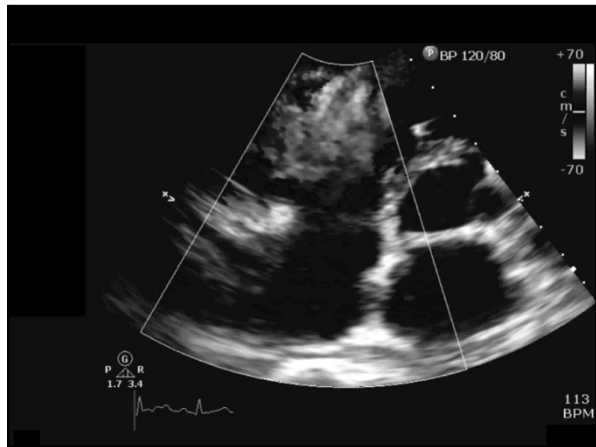
Covered by iv board spectrum antibiotics initially and subsequently switched to iv vancomycin

Cheitlin MD et al. ACC/AHA/ASE 2003 guideline update for the clinical application of echocardiography *J Am Coll Cardiol* 2003;42:954-970.









Echocardiographic findings:
 Multiple, large tricuspid valve vegetations
Destruction of TV
 Wide open, severe tricuspid regurgitation
 ? Tricuspid annular abscess
 Dilated right heart chambers
 RV and LV systolic dysfunction

Repeat CT thorax
 Patchy opacities & thin walled cavitory lesions
 Vascular ectasia - ? Pulmonary artery **aneurysms**

Op – tricuspid valve repair – bicuspidization and annuloplasty
Mitral valve repair, suture of perforation of PMVL

Chen H, MD et al. ACC/AHA/ASE 2003 guideline update for the clinical application of echocardiography. J Am Coll Cardiol 2003;42:954-970.

Right sided IE

- High recurrence rate of IE due to continued drug abuse → surgery should generally be avoided in IVDA with right-sided native IE except in:
- Right HF secondary to severe tricuspid regurgitation with poor response to diuretic therapy
- IE caused by organisms that are difficult to eradicate (e.g. persistent fungi) or bacteraemia > 7 days (e.g. S. aureus, Pseudomonas aeruginosa) despite adequate antimicrobial therapy
- Tricuspid valve vegetations >20 mm that persist after recurrent pulmonary emboli

65 years old male

h/o i) bicuspid AV and RHD S/P AVR and MVR
AV prosthesis – moderate paravalvular regurgitation
ii) monomorphic VT S/P AICD

Admitted for:

- i) Unwitnessed fall – found in void deck; hypotensive on arrival of paramedics; unable to recall events.
- ii) Fever for 3 days

O/E: Alert

H – S1S2 ESM metallic clicks crisp

L – clear. Power all 4 limbs – 5/5

Cheitlin MD et al. ACC/AHA/AASE 2003 guideline update for the clinical application of echocardiography J Am Coll Cardiol 2003;42:954–970.

Investigations –

TW 18 (Neutrophils 94%), Hb 7.2 g/dL, Plt 208, INR 5.7
Na 133, K 3.5, U 8.7, Cr 104

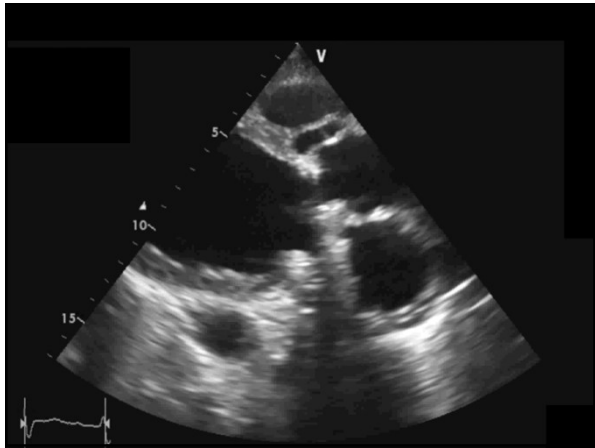
Trop I 0.704

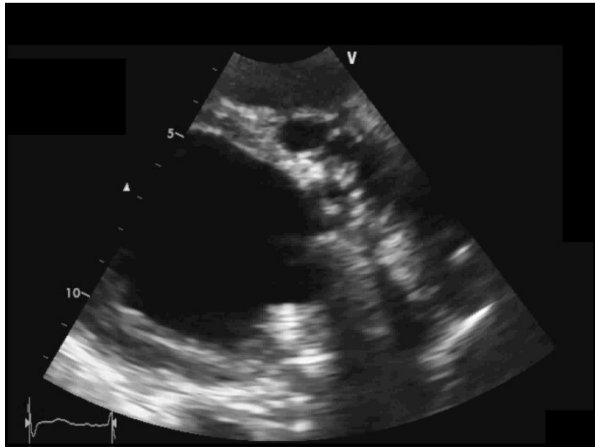
CXR – clear lung fields

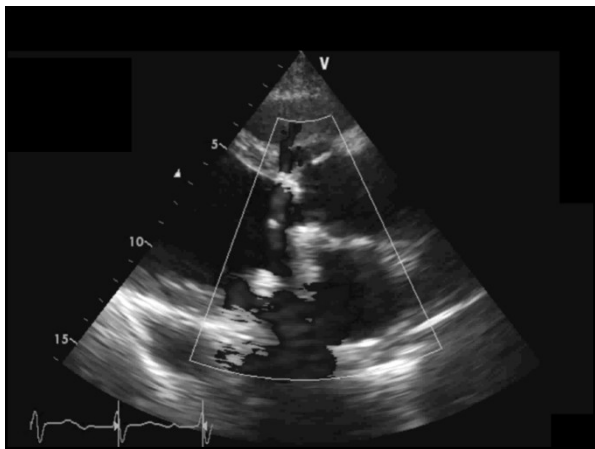
CT brain – hypodense lesion at left parietal cortex

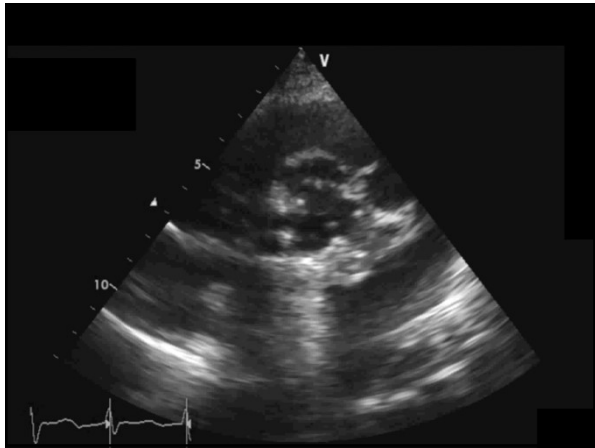
Echocardiography

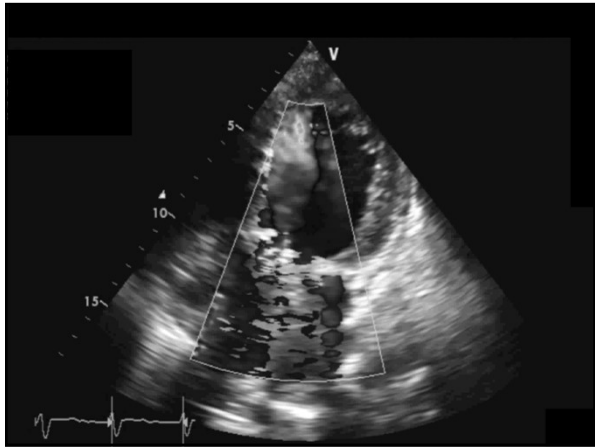
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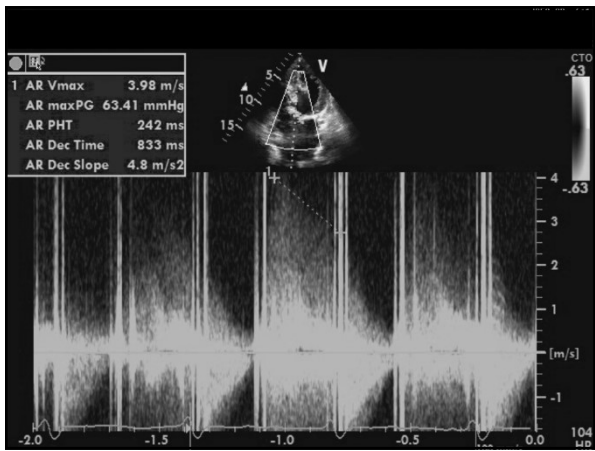












Prosthetic aortic valve infective endocarditis with **aortic root abscess**
Valve dehiscence
Complicated by **septic emboli**

Started on iv vancomycin, gentamicin, po rifampicin

Blood culture – Coagulase-negative staphylococcus (S epidermis sensitive to cloxacillin and rifampicin)

Cheitlin MD et al. ACC/AHA/ASE 2003 guideline update for the clinical application of echocardiography *J Am Coll Cardiol* 2003;42:954–970.

CTVS – for surgery after 2-3 weeks of antibiotics and when patient is stabilised

Become more septic and develop new right sided weakness

CT head – new left PCA territorial infarcts

Despite medical therapy - demise

Cheitlin MD et al. ACC/AHA/ASE 2003 guideline update for the clinical application of echocardiography *J Am Coll Cardiol* 2003;42:954–970.

Prosthetic valve endocarditis

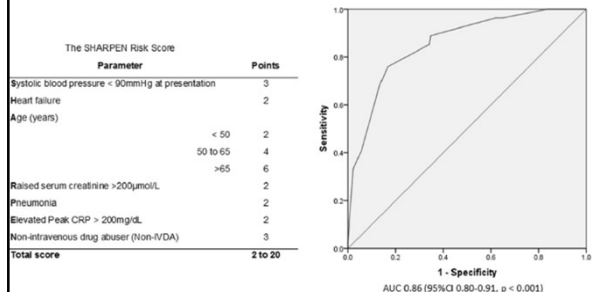
- The best therapeutic option in PVE is still debated.
- Early surgery was a/w lower in-hospital and 1-year mortality.
- Surgical strategy is recommended for PVE in high-risk subgroups: HF, severe prosthetic dysfunction, abscess or persistent fever
- Emergency surgery → only in cases with refractory HF → pulmonary oedema or shock.
- Uncomplicated non-staphylococcal and non-fungal late PVE can be managed conservatively.

Habib G, et al. Prosthetic valve endocarditis: who needs surgery? A multicentre study of 104 cases. *Heart* 2005;91:954–959.

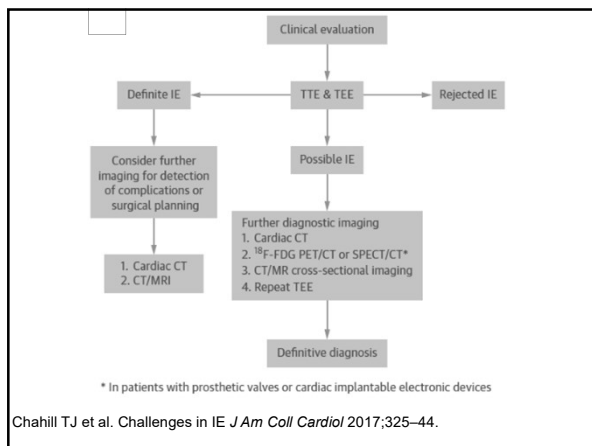
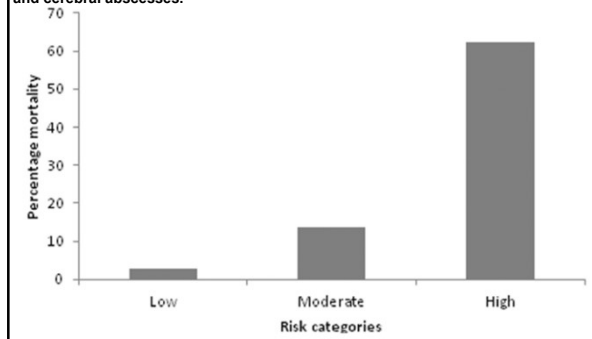
The SHARPEN clinical risk score predicts mortality in patients with infective endocarditis: An 11-year study²⁷

Qiao-Zhi Chee^{A,1}, Yong-Qiang Benjamin Tan^{B,1}, Jinghao Nicholas Ngiam^A, Ma Thin Mar Win^A, Xiayan Shen^B, Jia-Neng Jack Choo^A, Yong-Huak Chan^A, Paul Ananth Tambyah^{A,2}, Kian-Keong Poh^{A,3,4}

233 IE; age 50+/-19 years. Commonest organism Staphylococcus aureus (48%). In-hospital mortality rate was 23%. All deaths were due to IE or its complications



In-hospital deaths due to IE or its complications, including severe sepsis (48%), pneumonia, decompensated heart failure, massive haemorrhage secondary to coagulopathy, cerebrovascular accident and cerebral abscesses.



Challenges in Infective Endocarditis

Thomas J. Cahill, MBBS,^a Larry M. Baddour, MD,^b Gilbert Habib, MD,^{c,d} Bruno Hoen, MD, PhD,^e
Erwan Salaun, MD,^f Gosta B. Pettersson, MD, PhD,^g Hans Joachim Schäfers, MD,^h Bernard D. Prendergast, DM^h

CENTRAL ILLUSTRATION Infective Endocarditis: Preventive Strategies, Diagnosis, and Management

Preventive strategies	Improving diagnosis	Optimal management
<ul style="list-style-type: none"> Reduce hospital acquired bacteremia Good oral hygiene for at-risk groups Antibiotic prophylaxis for high risk groups In future, antibacterial coatings/materials 	<ul style="list-style-type: none"> High index of clinical suspicion in at-risk groups Patient education Early echocardiography Adjunctive imaging if echocardiography non-diagnostic Rapid microbiology results with antibacterial sensitivity 	<ul style="list-style-type: none"> Evaluation by an endocarditis team Early risk stratification Early transfer to center of expertise Tailored antibiotic therapy Early surgery for selected patients Monitoring for complications

Cahill, T.J. et al. J Am Coll Cardiol. 2017;69(3):325-44.

Thankyou

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