Infective Endocarditis:
Surgical & Critical Care Issues

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Incident Rates of Infective Endocarditis (IE)

- 3rd-4th most common life-threatening infection syndrome
- Increasing M&M
- Relatively rare (3-7/100,000 person-years)
Incident rates of Infectious Endocarditis (IE)

- “The average general practitioner will see one case every 20 years” Cahill TJ, et al. BMJ 2017;358:j3942
- Symptoms of subacute IE: fever, chills, sweats, malaise, anorexia, weight loss
- This can result in the following:
  - Inappropriate antibiotic treatment (interferes w/ sensitivity of subsequent blood cultures)
  - Delays in diagnosis/appropriate therapy
  - Educational opportunity for @ risk patients
CONCLUSION!!!

- Infective Endocarditis is a complex disease with the potential for multi-system complications. Patients with this disease always require a combined Medical – Surgical approach.
CABG Patient

PCP/ER

Cardiology

CABG pt

Cardiac Surgery
Valve Patient

PCP/ER → Valve pt → Cardiac Surgery

Cardiology → Valve pt → Cardiac Surgery
Infective Endocarditis (IE)

**Surgical Issues**

- Effects of Anatomy & Cardiac Physiology
- Native vs. Prosthetic Valve Endocarditis
- Diagnosis
- Timing of Surgery
- Procedure(s)
Infective Endocarditis (IE)

**Critical Care Issues**

- Control & Eradication of Infection
- Hemodynamic Management
- Management of Complications
Surgical Anatomy & Cardiac Physiology

Valvular Consequences

- Insufficiency – Native vs. Prosthetic
- Destruction/Disruption
- Emboli
Factors Predisposing to the Development of Infectious Endocarditis (IE)

- Age > 60 years
- Male
- IVDA, esp recurrent
Drug dependence-associated IE

• “These users (opioid nonmedical users of prescription pain relievers) are 40x more likely than the general population to use heroin or other injection drugs”

Incidence of hospital discharge diagnoses of drug dependence-associated IE

Hospital costs for patients with drug dependence-associated IE
Factors Predisposing to the Development of Infectious Endocarditis (IE)

- Age > 60 years
- Male
- IVDA, esp recurrent
- Poor dentition/dental infection
- VHD
- CHD
- Prosthetic Heart Valve(s)

- Prior bout of endocarditis
- Presence of intravascular device (PPM/ICD, HD/CV caths)
- Chronic HD
- HIV infection (independent risk factor from HIV)
- Immunosuppression
Infective Endocarditis Surgical Pathology

- Vegetations
  - Layers of fibrin & platelets
  - Microorganisms
  - Layers pose mechanical barrier btw antibiotics & embedded microorganisms

- Tissue Destruction, Perforation, Chordal Rupture

- Extension from valve leaflets to annulus & beyond
Prosthetic Valve Endocarditis (PVE)
Prosthetic Valve Endocarditis (PVE)
Surgical Anatomy & Cardiac Physiology

Myocardial Consequences

- Sudden changes in volume & pressure loads due to sudden valve incompetence
- Pressure may cause abscesses to progress to fistulous tracts > intracardiac/pericardial shunts
- Necrotic tissue

Intracardiac Spread of Infection

- Aortic to Mitral & Vice Versa
- Involvement of Conduction System*
- Security of Prior Repair / Replacement
Diagnosis of Endocarditis

• **Classic manifestations:**
  1. Sustained bacteremia or fungemia
  2. Evidence of active valvulitis
  3. Peripheral emboli
  4. Immunologic vascular phenomena

• **Modified Duke Criteria:** Stratifies patients w/ suspected IE into 3 categories:
  
  **Definite:** 2 major criteria, or 1 major criterion & 3 minor criteria, or 5 minor criteria
  
  **Possible:** 1 major criterion & 1 minor criterion, or 3 minor criteria
  
  **Rejected:** another firm diagnosis, resolution of syndrome < 4 days of antibiotics, no pathological evidence of IE @ surgery/autopsy < 4 days of antibiotics
Modified Duke Criteria for Diagnosis of IE

- **Major Criteria**
  1. Positive blood cultures for typical IE organisms
  2. Evidence of endocardial involvement (*oscillating intracardic mass/vegetation on valve or supporting structures, annular/septal abscess, new valve regurgitation, new partial dehiscence of PV*)

- **Minor Criteria**
  1. Predisposition, predisposing heart condition, or IVDA
  2. Fever > 38
  3. Vascular phenomena: major arterial emboli, septic pulm emboli, mycotic aneurysm, intracranial hemorrhage, conjunctival hemorrhage, Janeway lesions
  4. Immunological phenomena: glomerulonephritis, Osler nodes, Roth spots, rheumatoid factor
  5. Microbiological evidence: +BC but does not meet a major criteria
Diagnosis of Infectious Endocarditis

Signs and Symptoms

• CHF
• Emboli
• Infection
Progression of CHF

“3 hour tour”
Diagnosis of Endocarditis

- Emboli ~ small

*Petechiae* – finger tips/toes; most common

*Splinter hemorrhages* – nonblanching, linear, reddish-brown nail bed lesions

*Osler nodes* – painful, violaceous nodules found in the pulp of fingers & toes

*Janeway lesions* – macular, nonpainful, erythematous lesions of the palms & soles

*Roth spots* – exudative, edematous hemorrhagic retinal lesions
Petechiae
Splinter hemorrhages
Osler nodes
Janeway lesions
Roth spots
Diagnosis of Endocarditis

Emboli ~ large
Diagnosis of Endocarditis

Emboli ~ large
Risk of Embolization

- Occurs 22-50% of cases of IE
- Up to 65% involve CNS, w/ >90% lodging in branch distribution of MCA
- Most occur w/in first 2-4 wks of antibiotic therapy
- ^risk: vegetation size, mitral valve involvement, staphylococcal pathogenesis
Diagnosis of Infectious Endocarditis (IE): Echocardiography

- **TTE** should be done ASAP for suspected IE
- **TEE** should be the study of choice for suspected PVE
## Timing of Surgery

### Table 5. Clinical and Echocardiographic Features That Suggest Potential Need for Surgical Intervention

<table>
<thead>
<tr>
<th>Vegetation</th>
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<tbody>
<tr>
<td>Persistent vegetation after systemic embolization</td>
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<tr>
<td>Anterior mitral leaflet vegetation, particularly with size &gt;10 mm*</td>
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<tr>
<td>≥1 Embolic events during first 2 wk of antimicrobial therapy*</td>
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<tr>
<td>Increase in vegetation size despite appropriate antimicrobial therapy*†</td>
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<tr>
<td>Valvular dysfunction</td>
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<tr>
<td>Acute aortic or mitral insufficiency with signs of ventricular failure†</td>
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<tr>
<td>Heart failure unresponsive to medical therapy†</td>
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<tr>
<td>Valve perforation or rupture†</td>
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<tr>
<td>Perivalvular extension</td>
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<tr>
<td>Valvular dehiscence, rupture, or fistula†</td>
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<tr>
<td>New heart block†</td>
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<tr>
<td>Large abscess or extension of abscess despite appropriate antimicrobial therapy†</td>
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</tbody>
</table>
Surgery in Patients w/ Prior Emboli/Hemorrhage/Stroke

- If stroke small/subclinical, w/out hemorrhage, w/ residual vegetation > consider surgery
- If stroke severe or hemorrhagic > delay surgery @ least 4 weeks
Mycotic Aneurysms (MAs)

- Uncommon yet dangerous complication
- Caused by septic embolization of vegetations to the arterial vasa vasorum (intraluminal space) with subsequent infectious spread through intima & outward through the vessel wall
- Frequency of occurrence: IC arteries > visceral arteries > UE/LE arteries
Intracranial MAs

- Dangerous complication, overall mortality 60% (unruptured 30%, ruptured 80%)
- Most commonly occur @ branch of MCA
- Presentation: Severe HA, AMS, focal deficits, erythrocytes/leukocytes/\textsuperscript{protein} in spinal fluid
Extracranial MAs

- Asymptomatic until leakage/rupture
- Hepatic artery: hematemesis, hematobilia, jaundice
- Renal artery: arterial HTN, hematuria
- Small/large bowel: massive bloody diarrhea
Procedures

- Debridement / Resection of all infection
  - Anatomic Limitations
    - Coronary
    - Conduction
    - Septal

- **Native** Valve Endocarditis
  - Valve Repair / Vegetectomy
  - Valve Replacement
  - Root Replacement
ENDOCARDITIS

Mitral Valve - Vegetectomy
ENDOCARDITIS

Mitral Valve – Repair of Perforated Leaflet
ENDOCARDITIS
Tricuspid Valve - Vegetectomy
ENDOCARDITIS
Aortic Valve Replacement
Procedures

• Debridement / Resection
  • Anatomic limitations
    • Coronary
    • Conduction
    • Septal

• **Prosthetic** Valve Endocarditis
  • Re-replacement of Valve
  • Aortic Root Replacement
Endocarditis
Aortic Valve Homograft w/ Root Replacement
Infective Endocarditis

Goals of Surgery

- Excise all infected tissue
- Patch all the holes &/or close fistulas
- Repair*/Replace the valve(s)
Infective Endocarditis

Critical Care Issues

• Control, Eradication & Sterilization of Infection
• Hemodynamic Management
• Management of Complications
Control & Eradication of Infection

Broad Spectrum to Narrow, Specific Antibiotic Rx, in consultation with *Infectious Disease specialist*

Duration is prolonged (>4 wks) & parenteral, OPAT

**Microbiology**

- Staphylococci* – MRSA, MSSA, Coag Neg
- Enterococci
- Streptococci viridans, bovis
- Gram Negative
- Polymicrobial
- Fungi

*Culture Negative or *Marianic* Endocarditis*
TVR patients w/ IE

Prevalence

- Enterococcus
- S. aureus
- CoNS
- VGS
Control & Eradication of Infection

Surveillance for Persistent Infection

- Clinical Indications
- Resistant Organisms
- Changing Resistance
- Especially if Prosthetic Material Still Present
Hemodynamic Management

- Management of Resolving CHF
- Conduction Abnormalities / Arrhythmias
- Control of Hypertension
- Monitoring for Disruption of Repair / Replacement
  - PE – New Murmur? > ECHO
Management of Complications

- CV: MI, CHF, Septic Shock, A-V Block, Arrhythmias
- Resp: Septic Emboli, Pneumonia, TRALI, ARDS
- Renal: AKI, Renal Emboli
- GI: Mesenteric emboli, splenic abscess/infarction, delayed splenic rupture
- Neuro: Embolic CVAs, Retinal emboli
- Hem: Coagulopathies/Anticoagulation Related
- Endo: Adrenal Insufficiency
- ID: Sepsis, Septic Shock, Septic Emboli
  (e.g. Splenic Abscesses, Mycotic Aneursyms)
Management of Low Cardiac Output

- Optimize the 5 Basic Parameters:
  - Heart rate / Rhythm
  - Preload
  - Afterload
  - Contractility
  - Surgical Result
    - Rx Mechanical/Anatomic Problem

- Consider Assist Device~ECMO
Summary

Infective Endocarditis is a complex disease that always requires a combined Medical – Surgical approach

• Timing of Each Component Important
• Specificity & Duration of Medical Rx Key
• Surgery Adjusted to the Anatomic Situation

Endocarditis has the potential for Multi-System Complications
Summary (cont)

Critical Care of the Postop Cardiac Surgical Pt:

- Hemodynamic Changes & Challenges
- Multi-System Monitoring & Management
- Close Surveillance for Complications & Persistent Infection