Infective Endocarditis & Prosthetic Joint Infections

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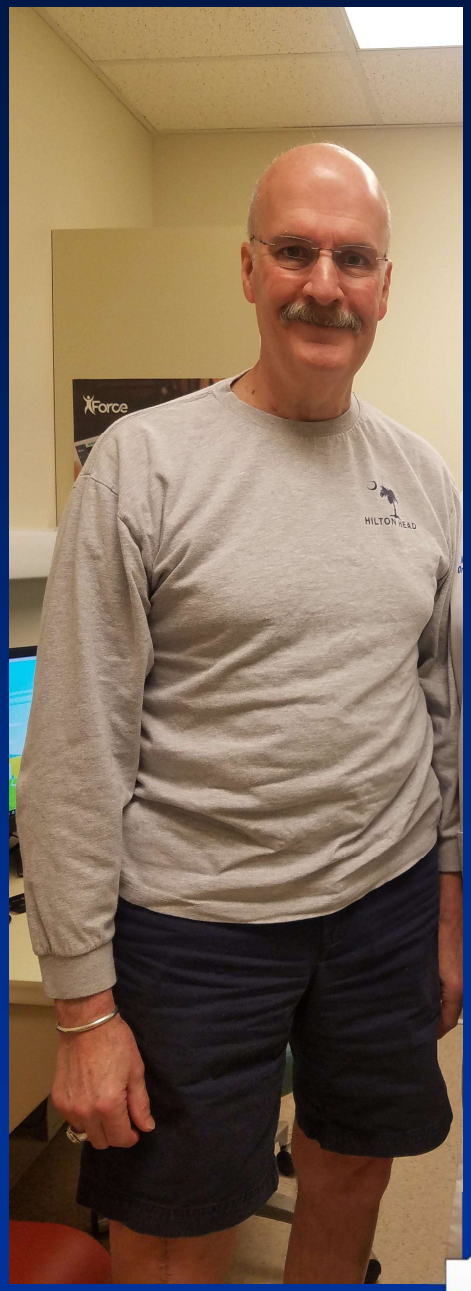
Disclosures

None

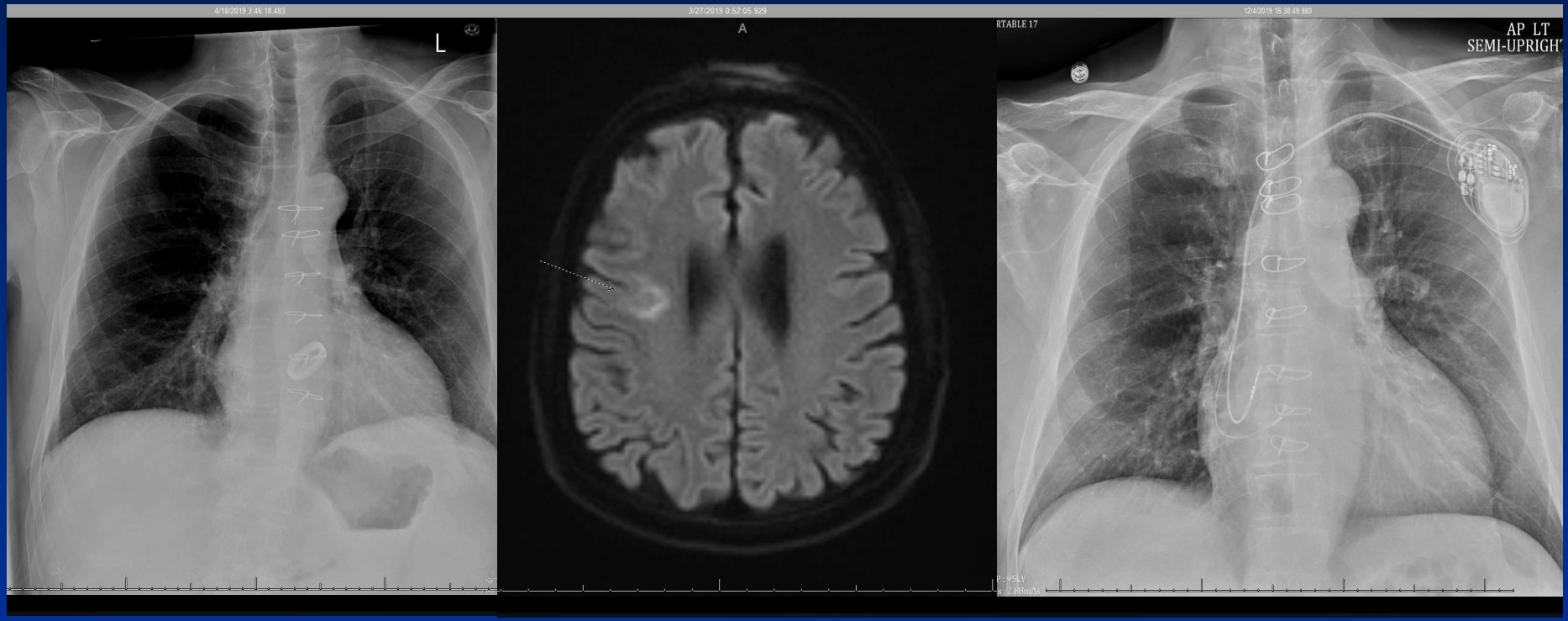
Learning Objectives

- Properly diagnosis and treat patients with endocarditis
- Properly diagnosis and treat patients with prosthetic joint infections
- Explain the mobility, mortality and economic burden of both endocarditis and prosthetic joint infections
- Identify the differences and similarities of patients with endocarditis and prosthetic joint infections
- Discuss how 'frontline' (Primary Care, Urgent Care, ICU, ER, MedSurg) PAs can have a timely and vital influence on patients with these serious infections

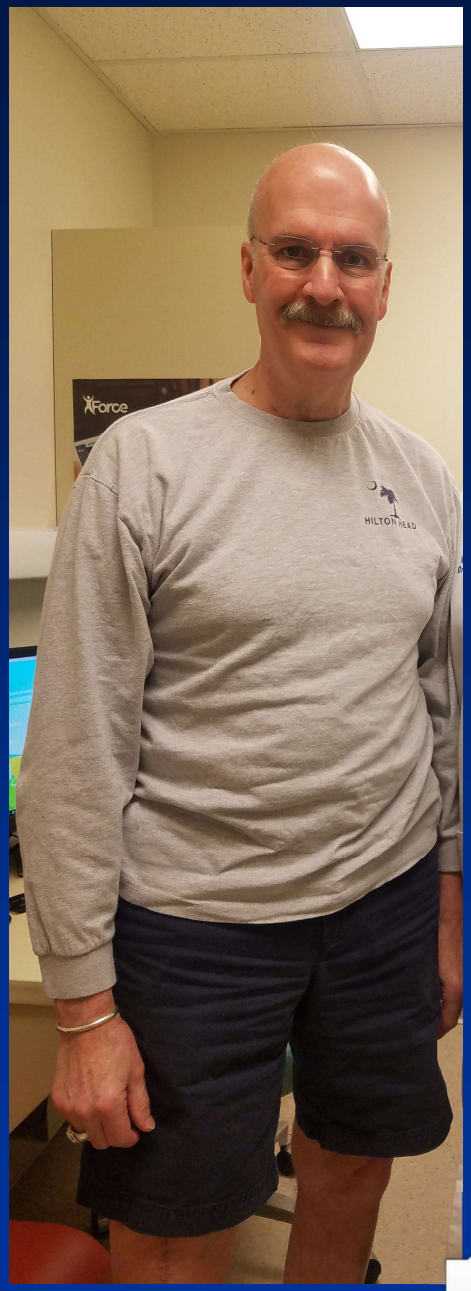
- In the spring of 2019, 64 year old male, presented with fever, chills, anorexia, weight loss, bacteremia & an acute right CVA
- Prior history of mechanical AVR & known TAA
- TEE revealed prosthetic valve endocarditis (PVE)
- Bacteria: Enterococcus
- Patient underwent Bentall procedure (Bioprosthetic AVR with synthetic tube graft replacement of root & ascending aorta) followed by 6 weeks of IV antibiotics
- Infection further complicated by CHB, requiring placement of PPM prior to discharge



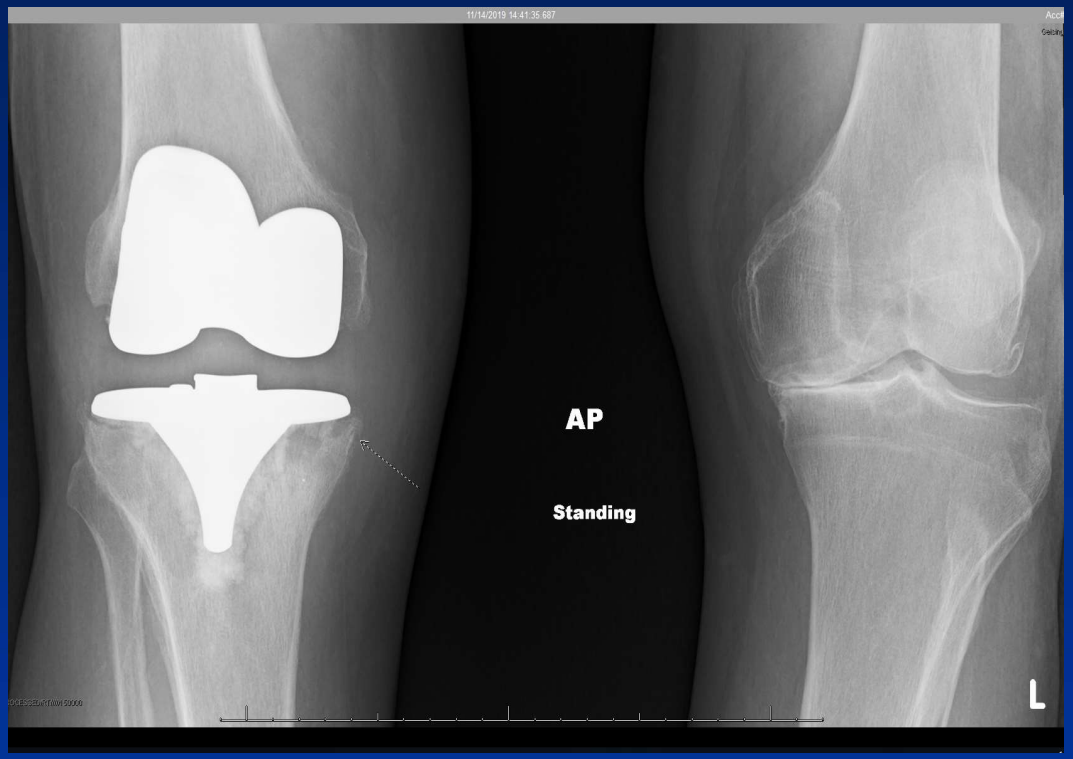
Endocarditis



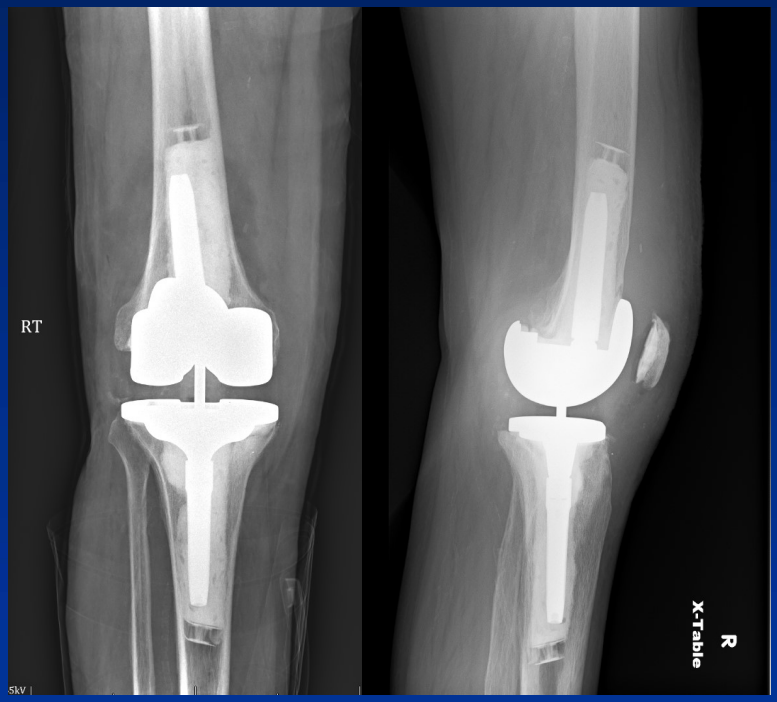
- In fall of 2019, after 2 months of a painful right prosthetic knee
- Aspiration of the knee revealed a prosthetic joint infection (PJI)
- Bacteria: Enterococcus
- Patient underwent 2-stage operation (explant of TKA HW/implant of antibiotic spacer, 6 weeks of IV antibiotics, followed by re-implantation of TKA HW/explant of antibiotic spacer)



Prosthetic Joint Infection

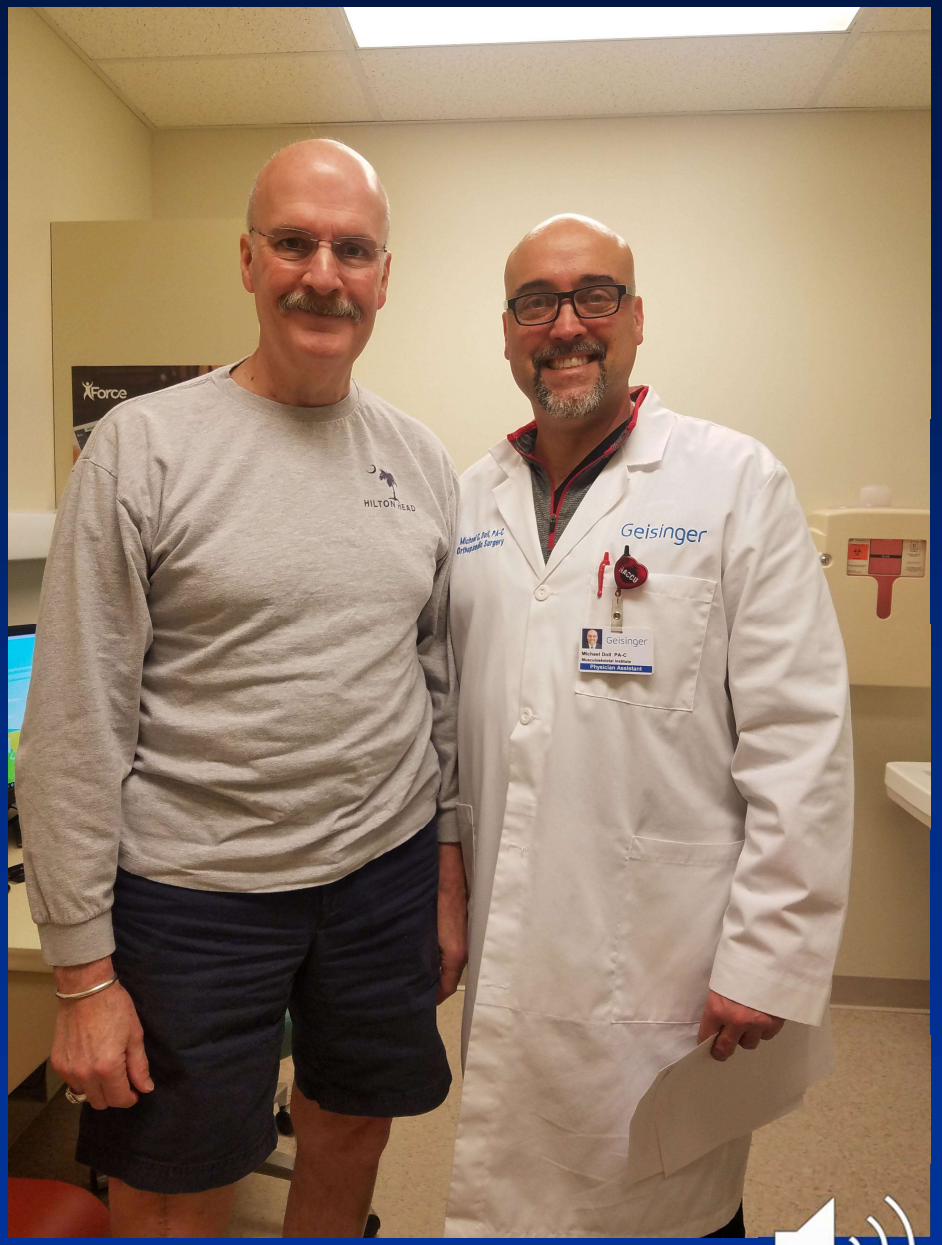


Prosthetic Joint Infection



Infective Endocarditis and Prosthetic Joint Infection

- Same Bacteria
- Same Patient
- Same PA



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)

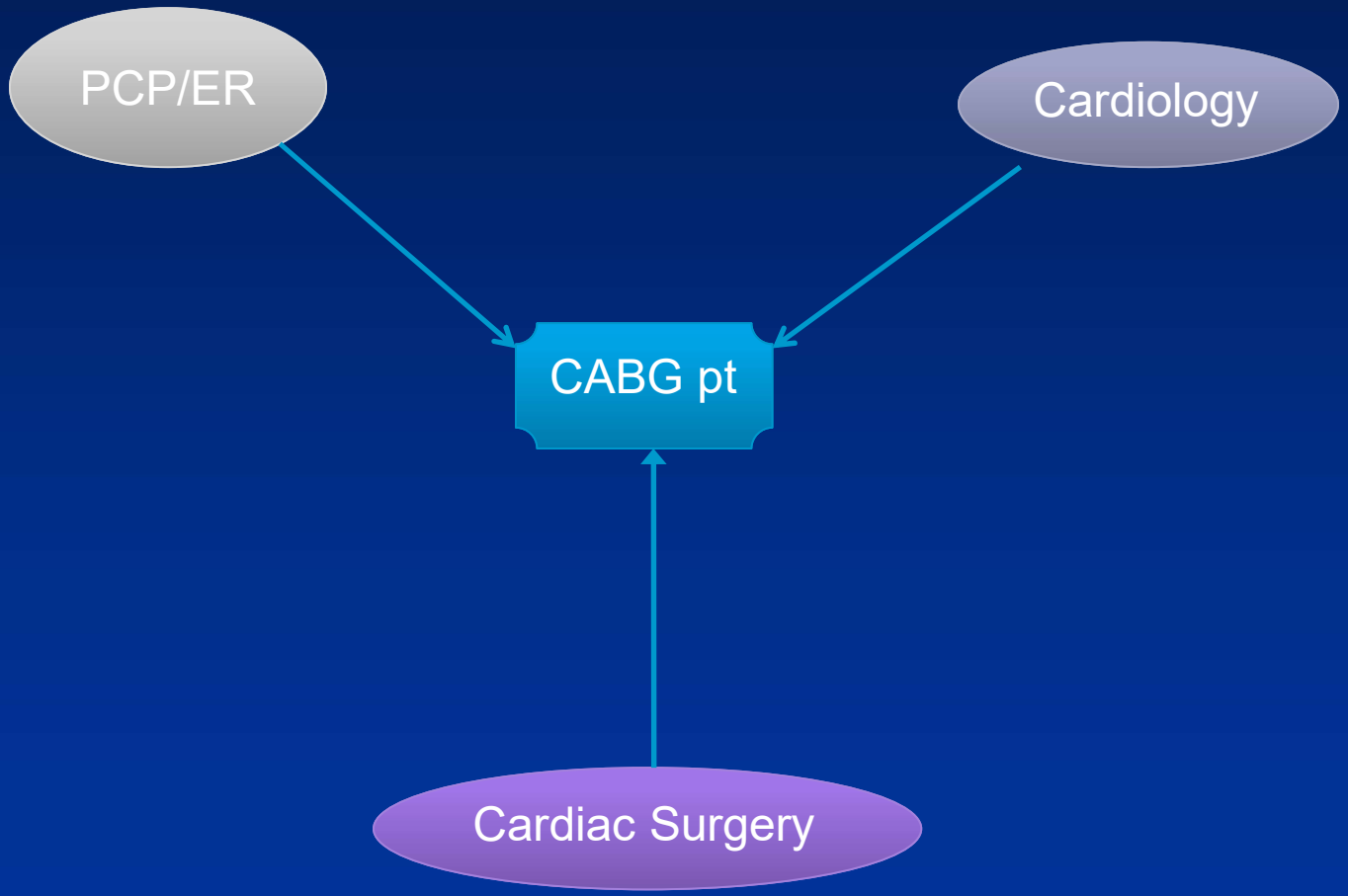
Incident rates of Infectious Endocarditis (IE)

- "*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 "frontline" providers

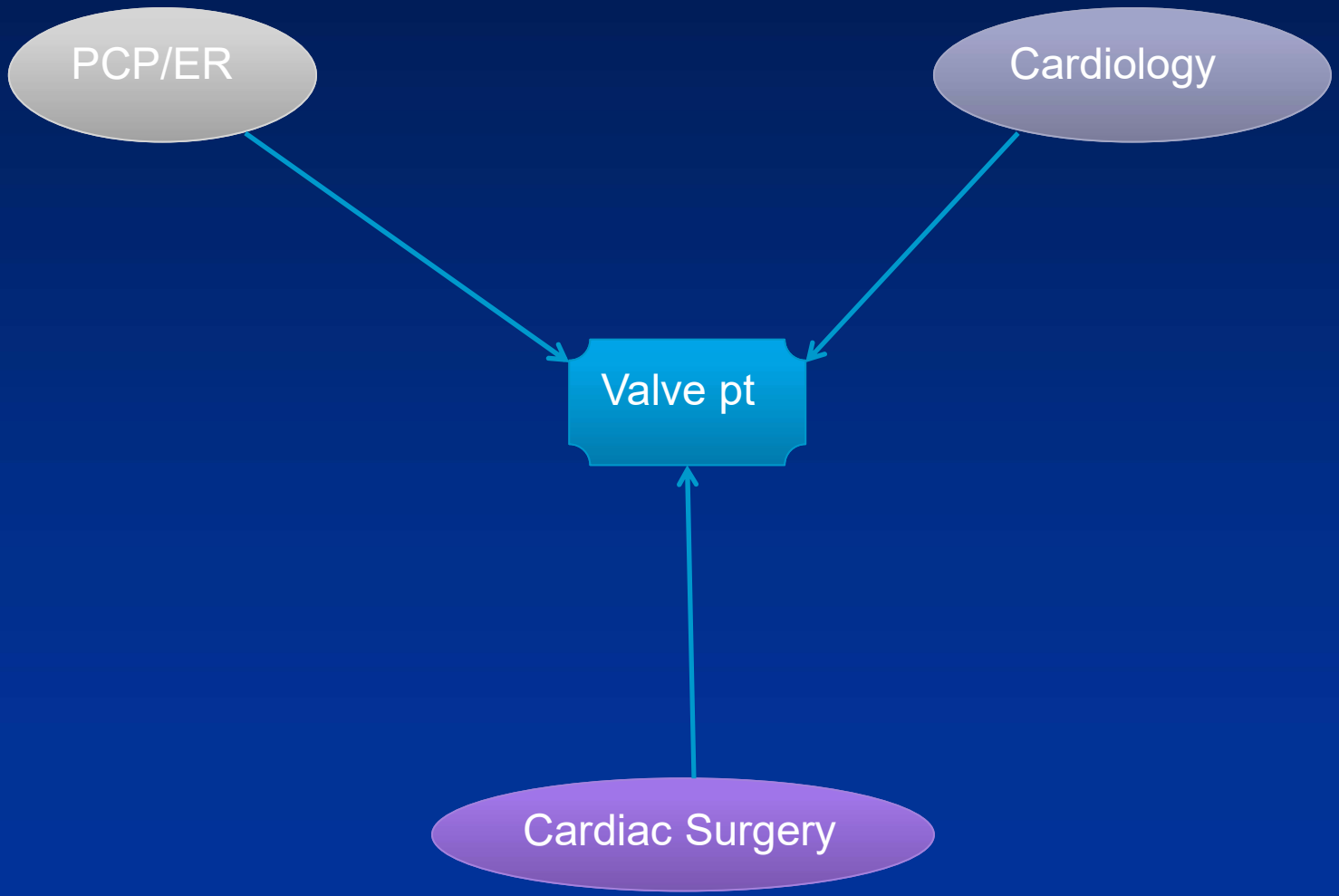
CONCLUSION!!!

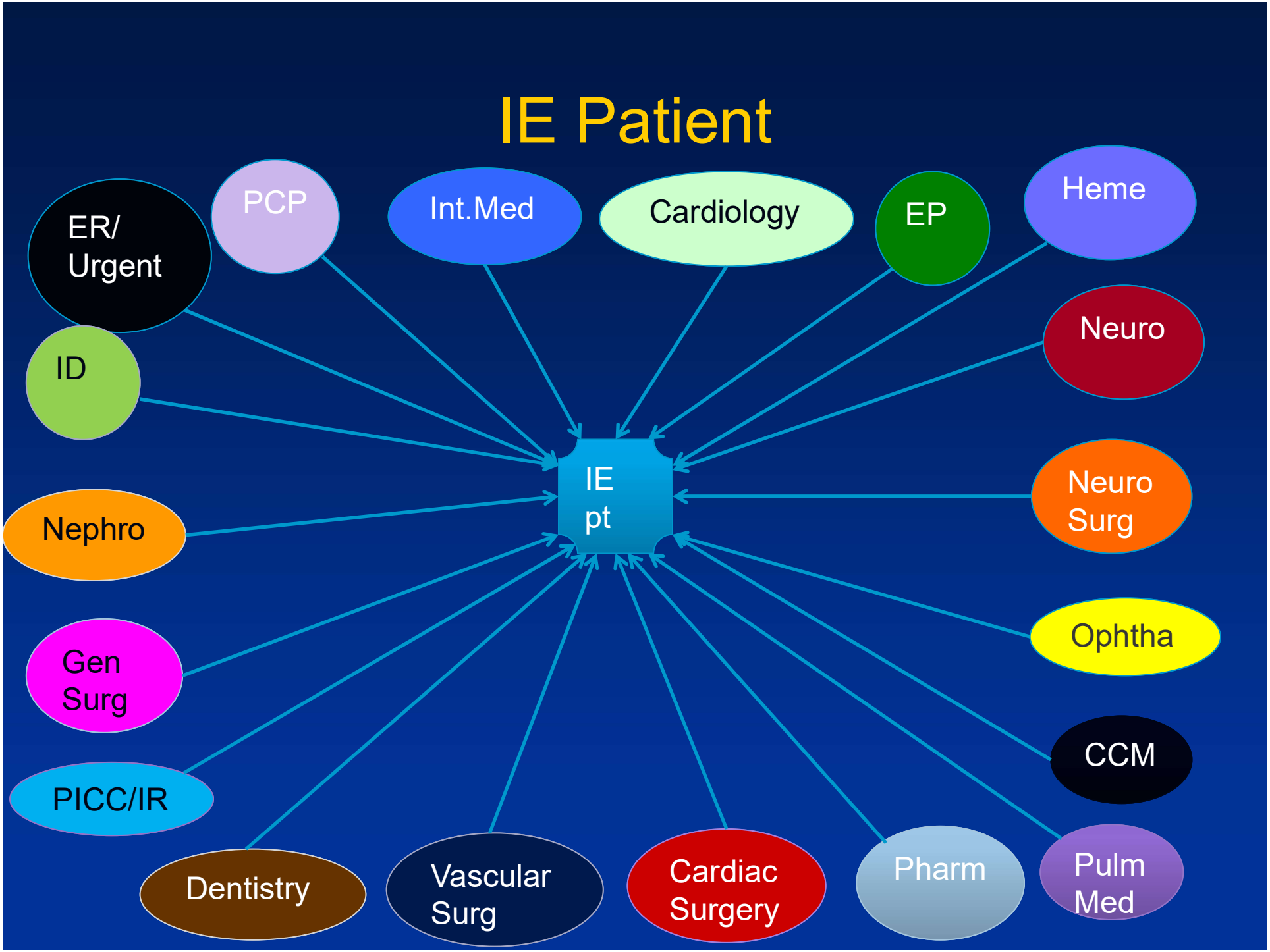
- Infective Endocarditis is a complex disease with the potential for multi-system complications. Patients with this disease always require a combined Medical – Surgical approach

CABG Patient



Valve Patient




IE Patient
ER/ Urgent
PCP
Int.Med
Cardiology
EP
Heme
ID
Neuro
IE pt
Nephro
Neuro Surg
Ophtha
Gen Surg
CCM
PICC/IR
Dentistry
Vascular Surg
Cardiac Surgery
Pharm
Pulm Med

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)

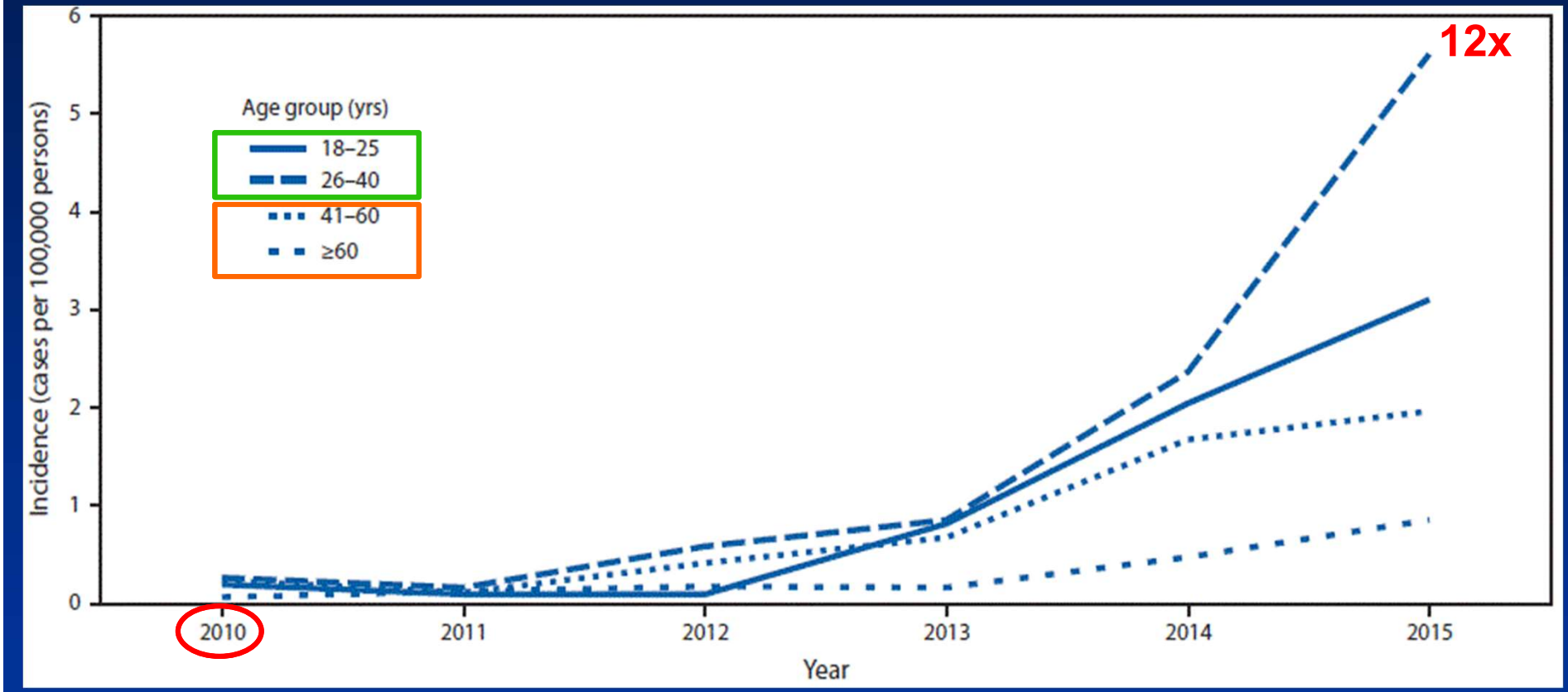
- Age > 60 years
- Male
- IVDA, esp recurrent

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"

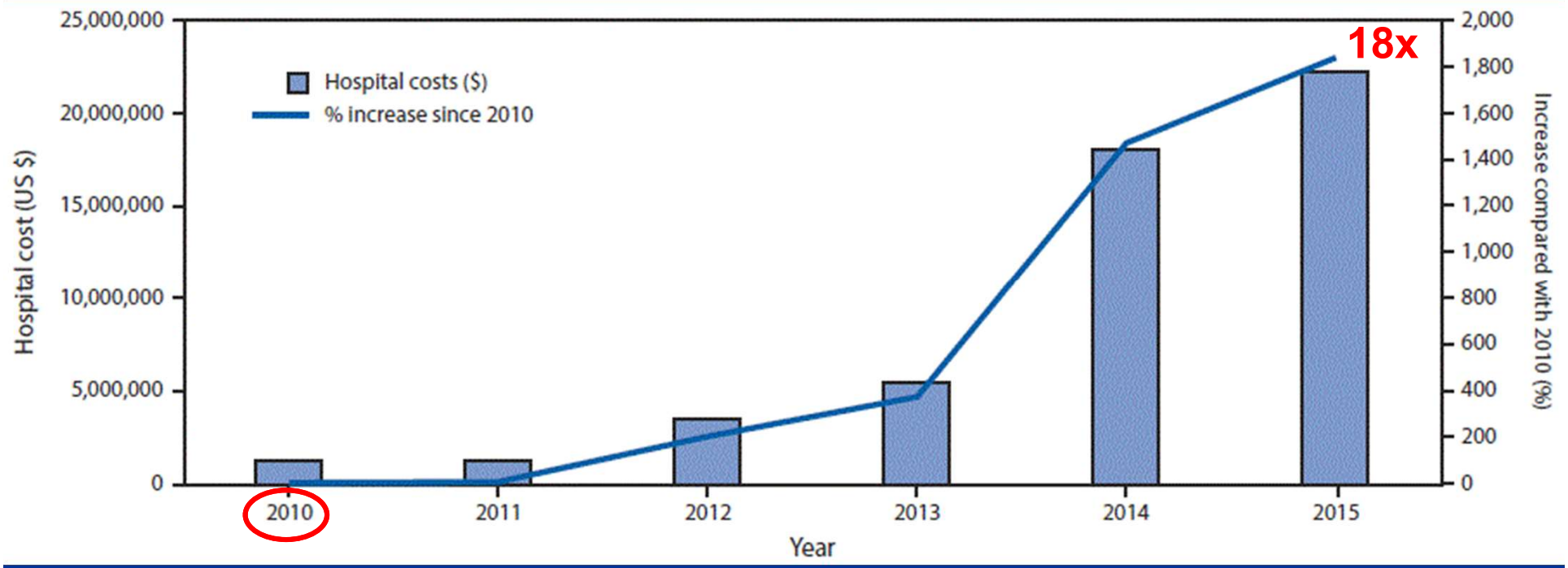
Fleischauer AT, et al. MMWR 2017;66:568-73.

Incidence of hospital discharge diagnoses of drug dependence-associated IE



Fleischauer AT, et al. MMWR 2017; 66:569-73.

Hospital costs for patients w/ drug dependence-associated IE



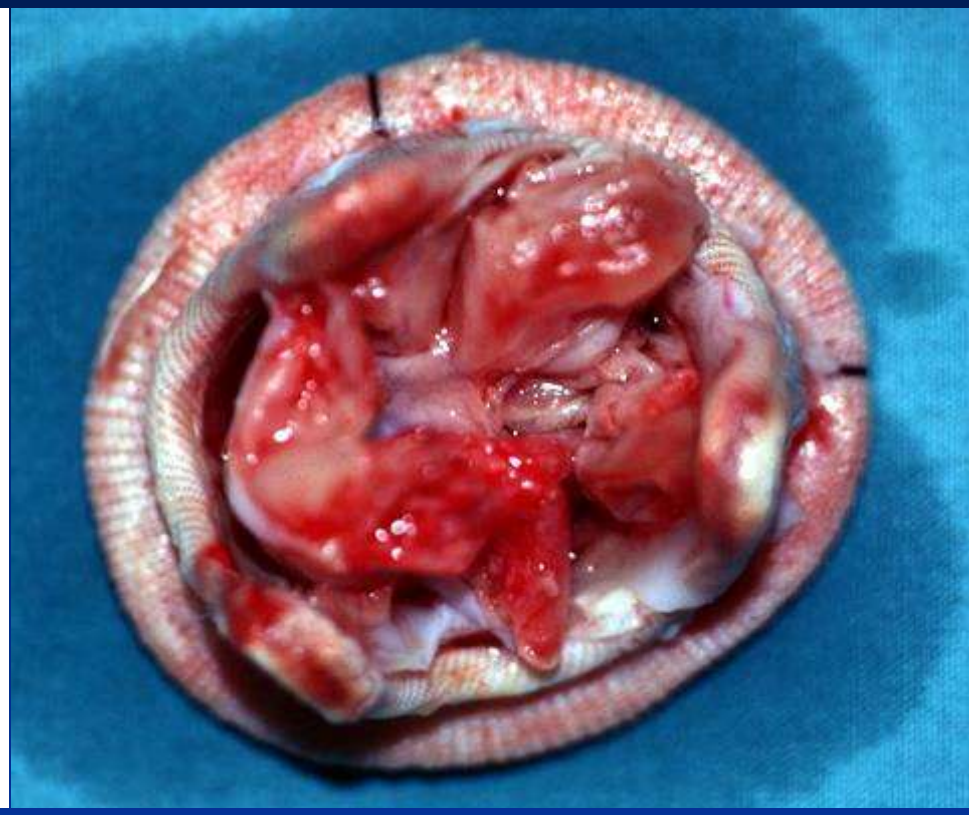
Factors Predisposing to the Development of Infectious Endocarditis (IE)

- 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

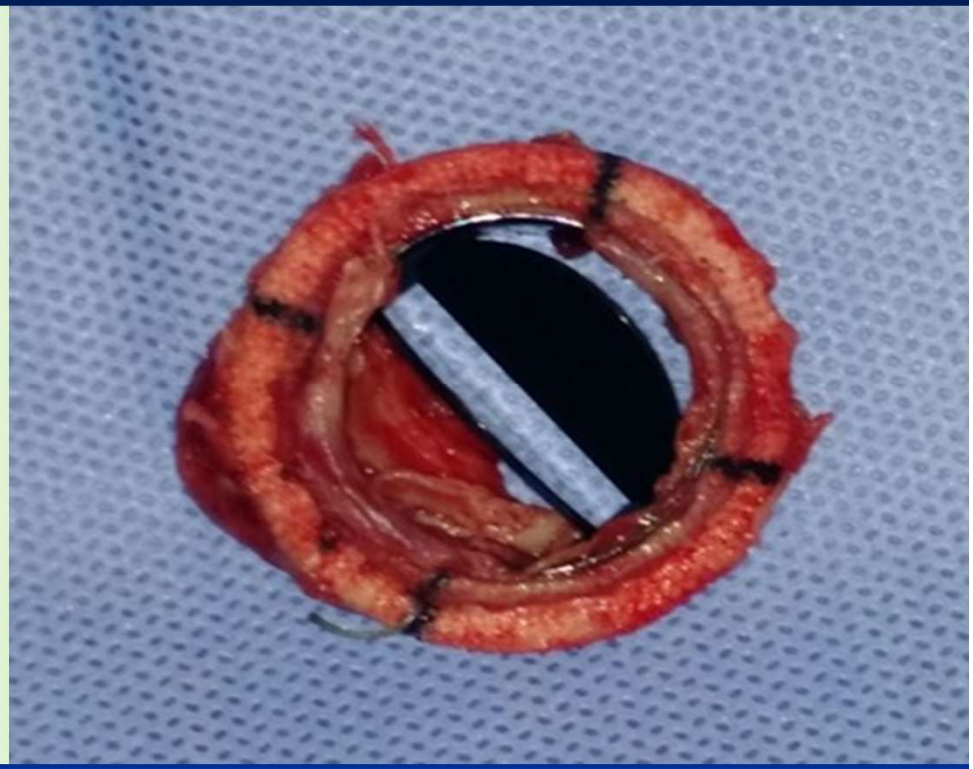
Infective Endocarditis Surgical Pathology

- What are Vegetations?
  - Composed of *microorganisms* that are w/in layers of fibrin & platelets
  - Layers pose mechanical barrier btw antibiotics & embedded *microorganisms*
- Leads to tissue destruction, perforation, chordal rupture
- Infection can then extend from valve leaflets to annulus & beyond
- Vegetations can ”break apart” & then embolize

Prosthetic Valve Endocarditis (PVE)



Prosthetic Valve Endocarditis (PVE)



Surgical Anatomy & Cardiac Physiology

Myocardial Consequences

- Sudden changes in volume & pressure loads from sudden valve incompetence
- Pressure may cause abscesses to progress to fistulous tracts>intra-cardiac/pericardial shunts

Intra-cardiac spread of infection

- Aortic to Mitral & Vice Versa
- Involvement of conduction system*
- Security of prior valve repair / replacement

Diagnosis of Endocarditis

- Classic manifestations:

1. Sustained bacteremia or fungemia
2. Evidence of active valvular involvement
3. Presence of peripheral emboli
4. Immunologic 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

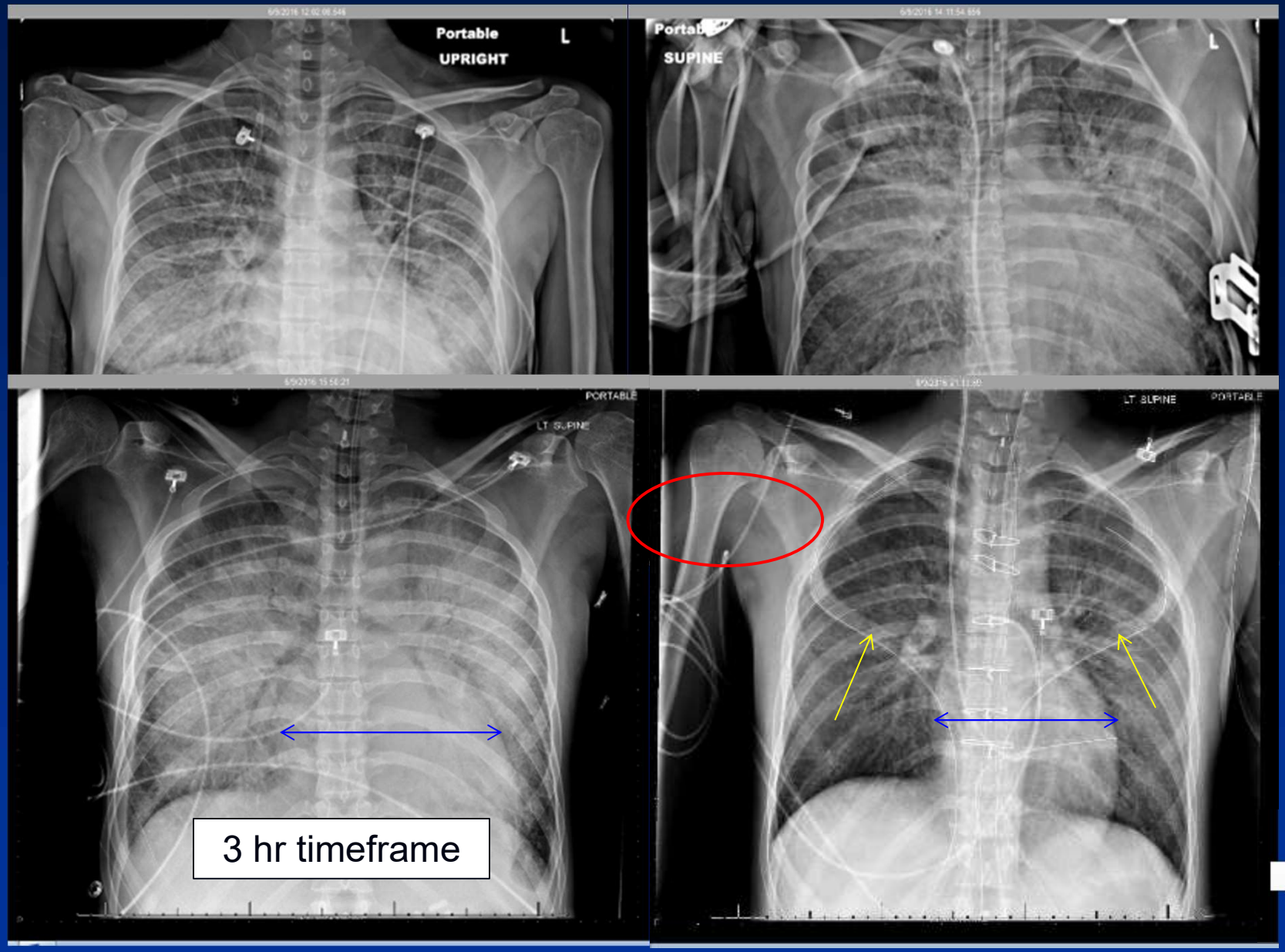
1. Predisposing heart condition or IVDA
2. Fever > 38
3. Vascular phenomena: major arterial emboli, septic pulm emboi, mycotic aneurysm, intracranial hemorrhage, conjunctival hemorrhage, Janeway lesions
4. Immunological phenomena: glomerulonephritis, Osler nodes, Roth spots, rheumatoid factor
5. Positive blood culture for an atypical major criteria bacteria

Diagnosis of Infectious Endocarditis

Signs and Symptoms

- CHF
- Emboli

Progression of CHF



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

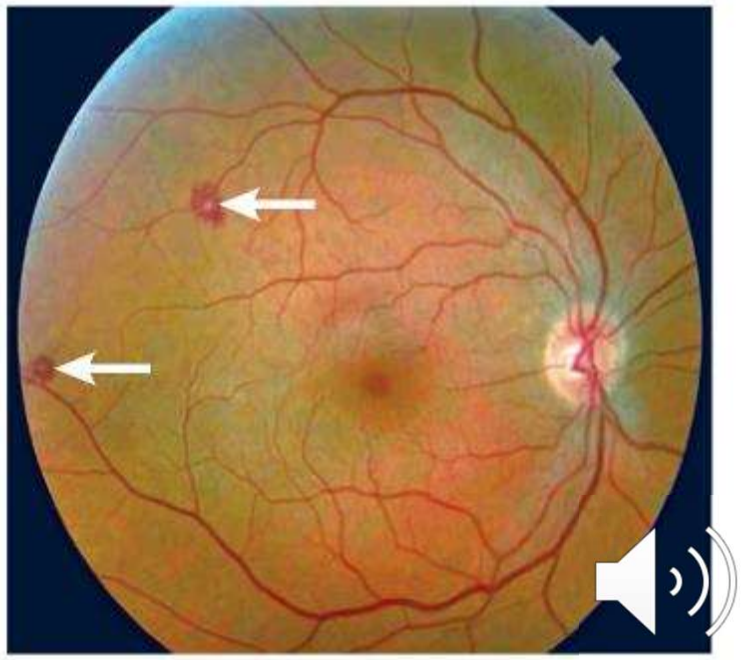
Petechiae

Splinter hemorrhages

Osler nodes

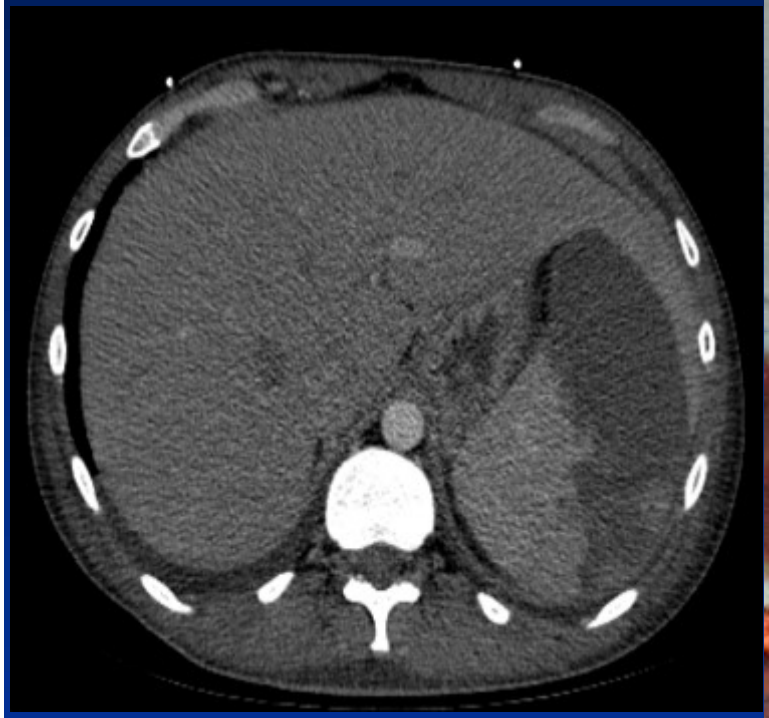
Janeway lesions

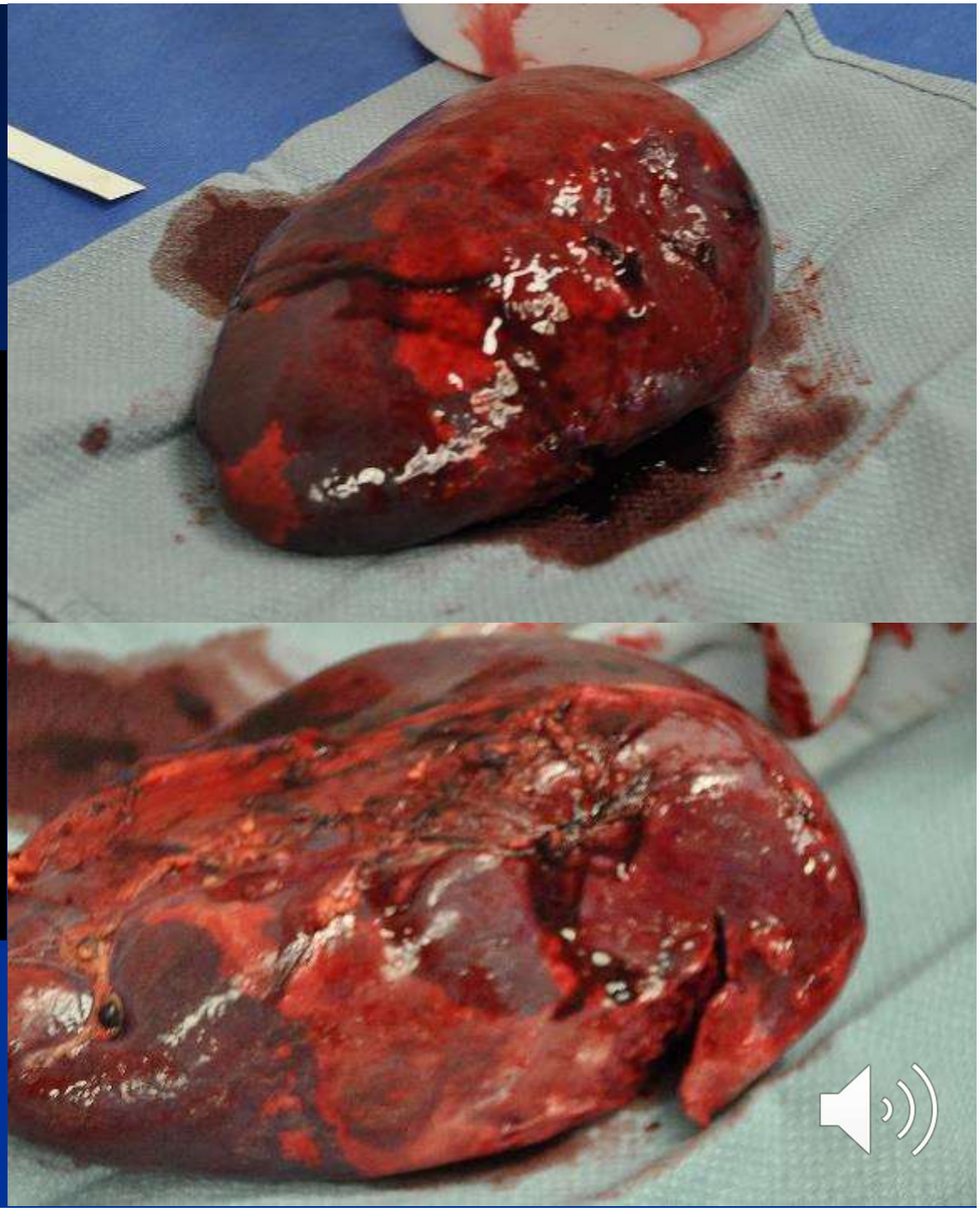
Roth spots



Diagnosis of Endocarditis

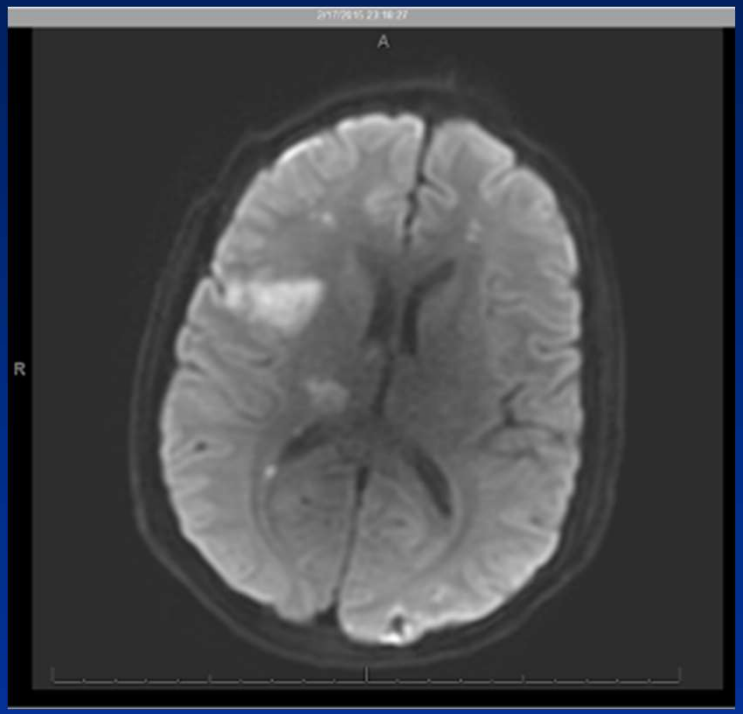
Emboli ~ large

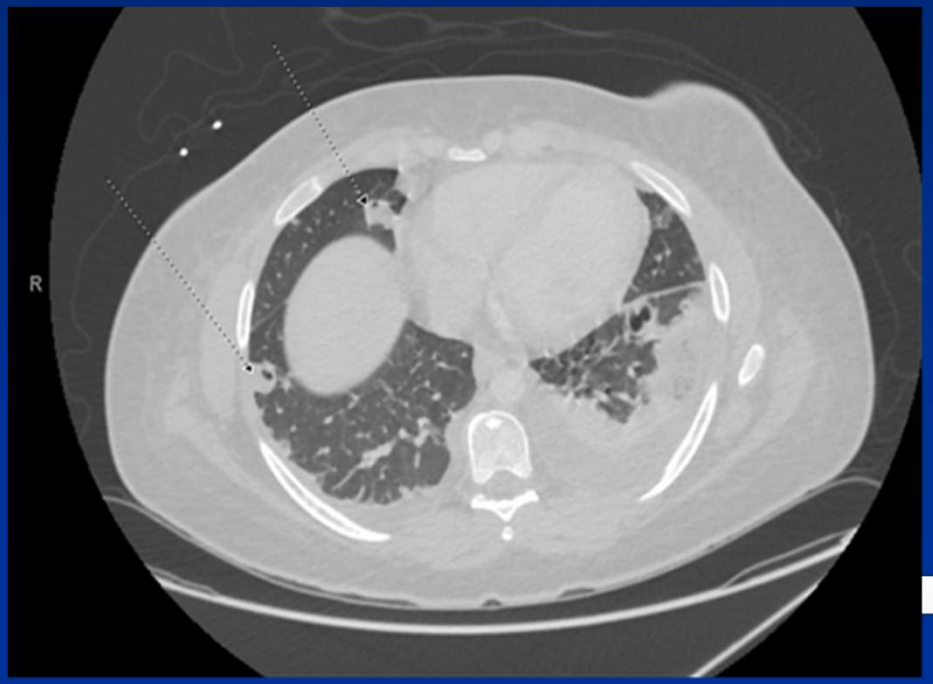




Diagnosis of Endocarditis

Emboli ~ large

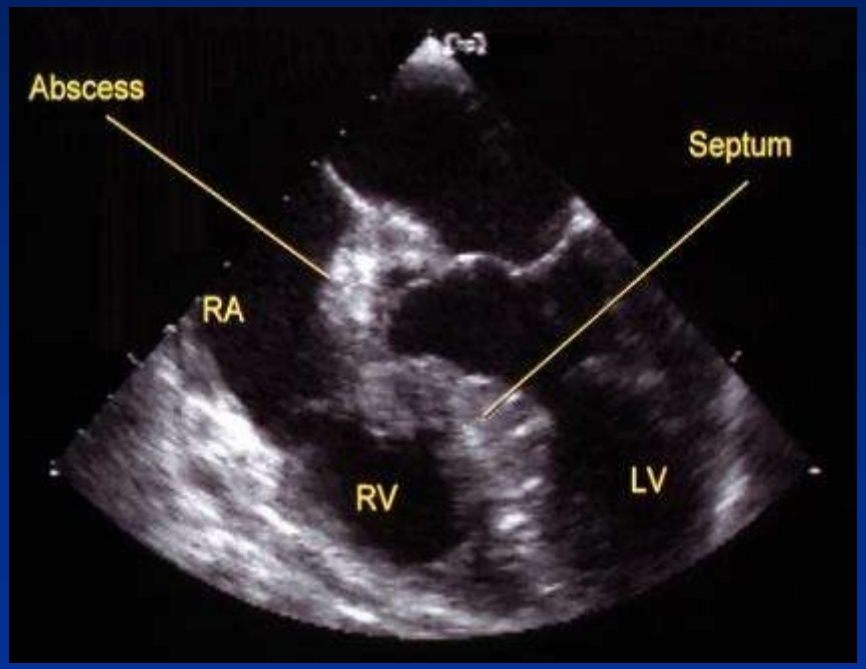




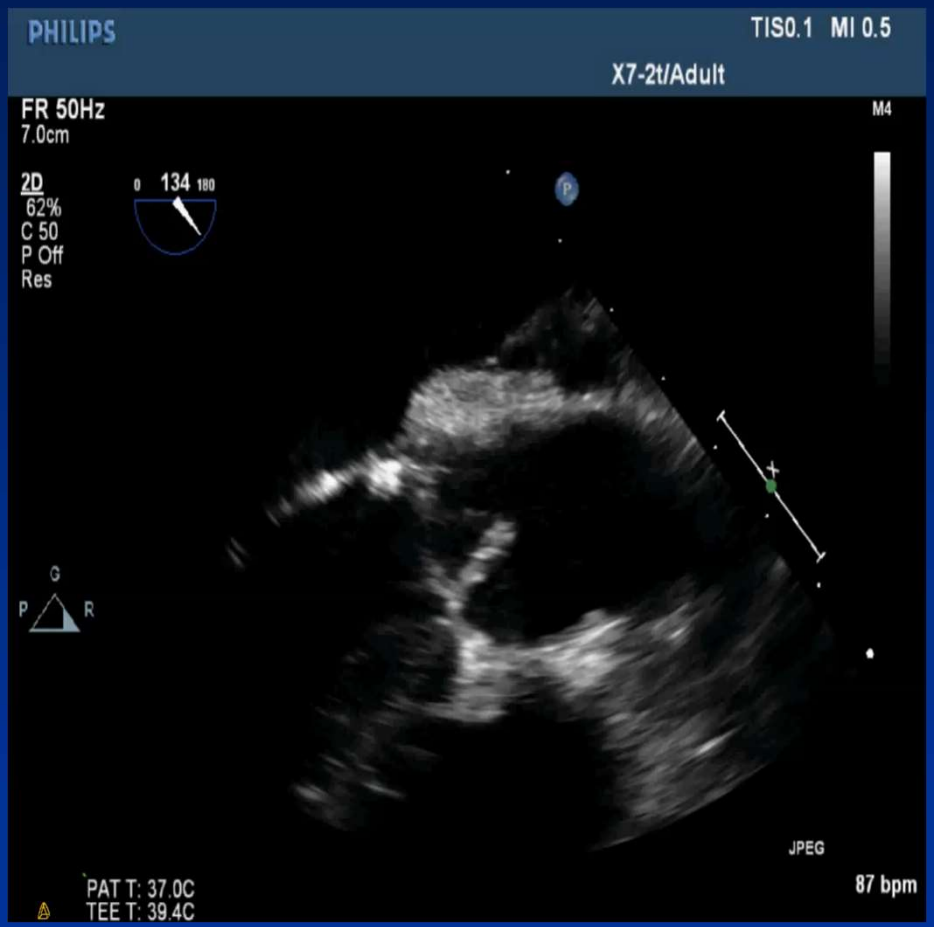
Risk of Embolization

- 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* native IE
- TEE should be the study of choice for *suspected* PVE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X7-2t/Adult
FR 50Hz
7.0cm
M4
2D
62%
C 50
P Off
Res
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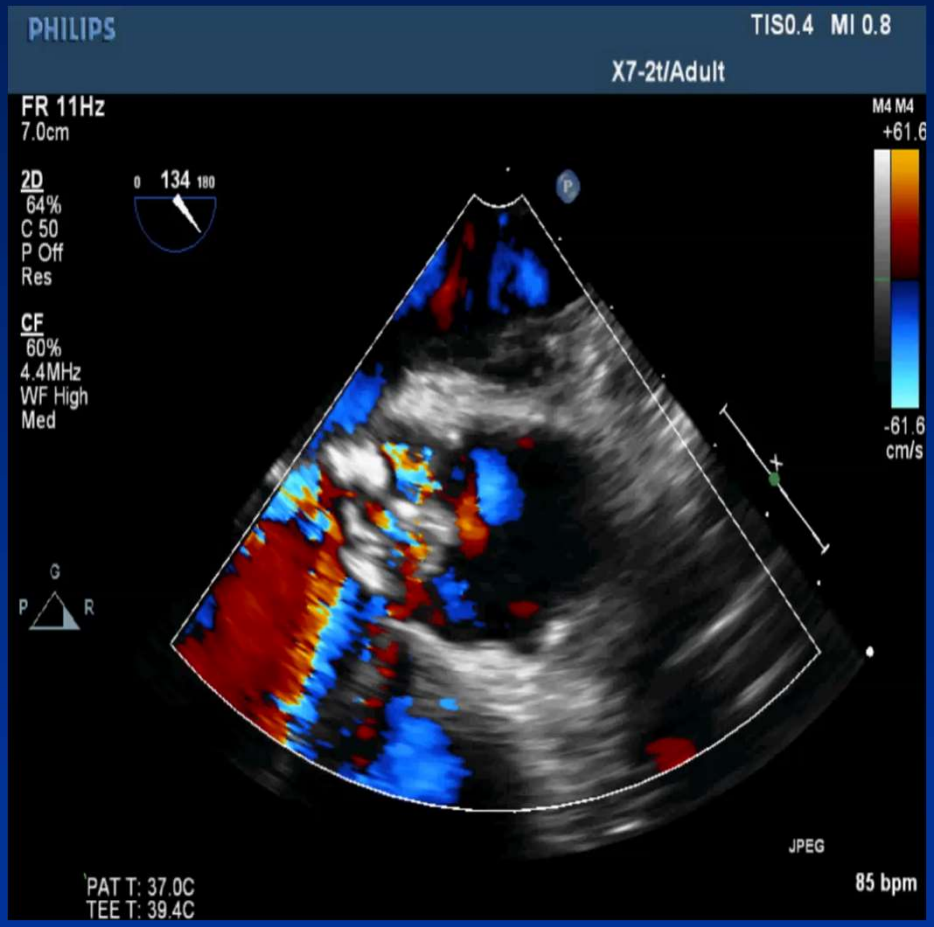
G
P
R
JPEG
PAT T: 37.0C
TEE T: 39.4C
87 bpm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7.0cm
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64%
C 50
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WF High
Med
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M4 M4
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-61.6
cm/s
G
P
R
JPEG
PAT T: 37.0C
TEE T: 39.4C
85 bpm


PHILIPS
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X7-2t/Adult
FR 50Hz
8.1cm
M4
2D
60%
C 50
P Off
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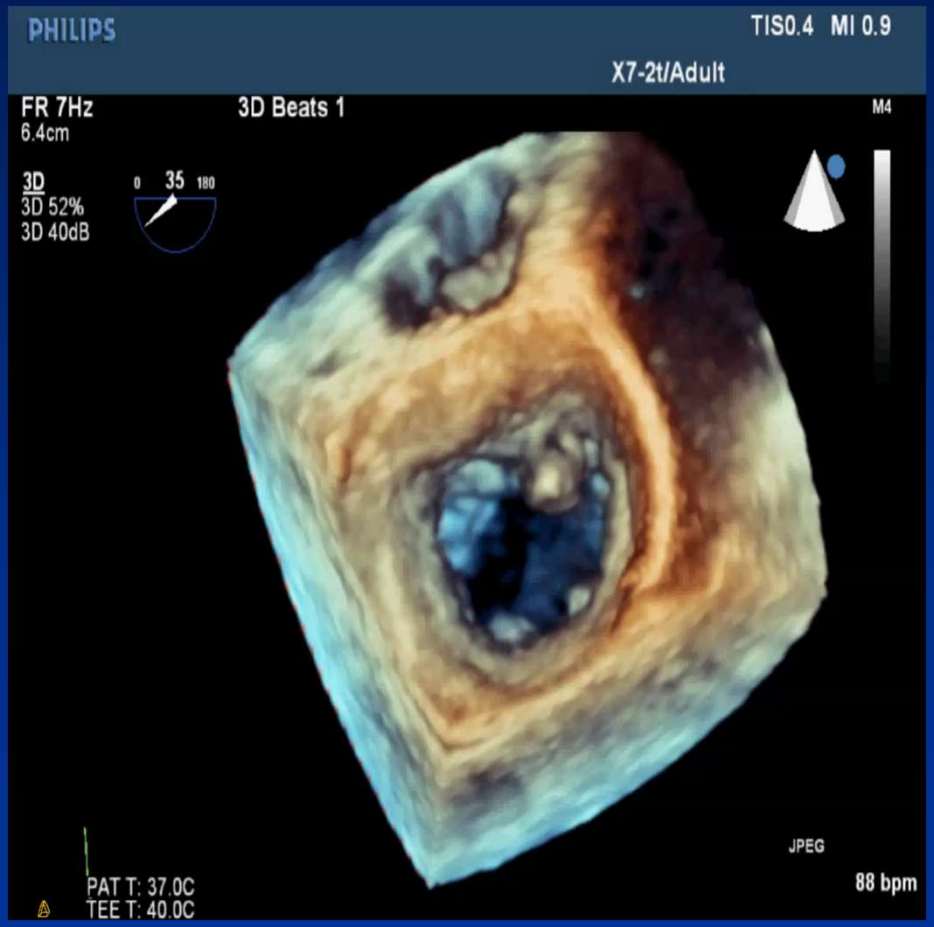
JPEG
PAT T: 37.0C
TEE T: 39.6C
93 bpm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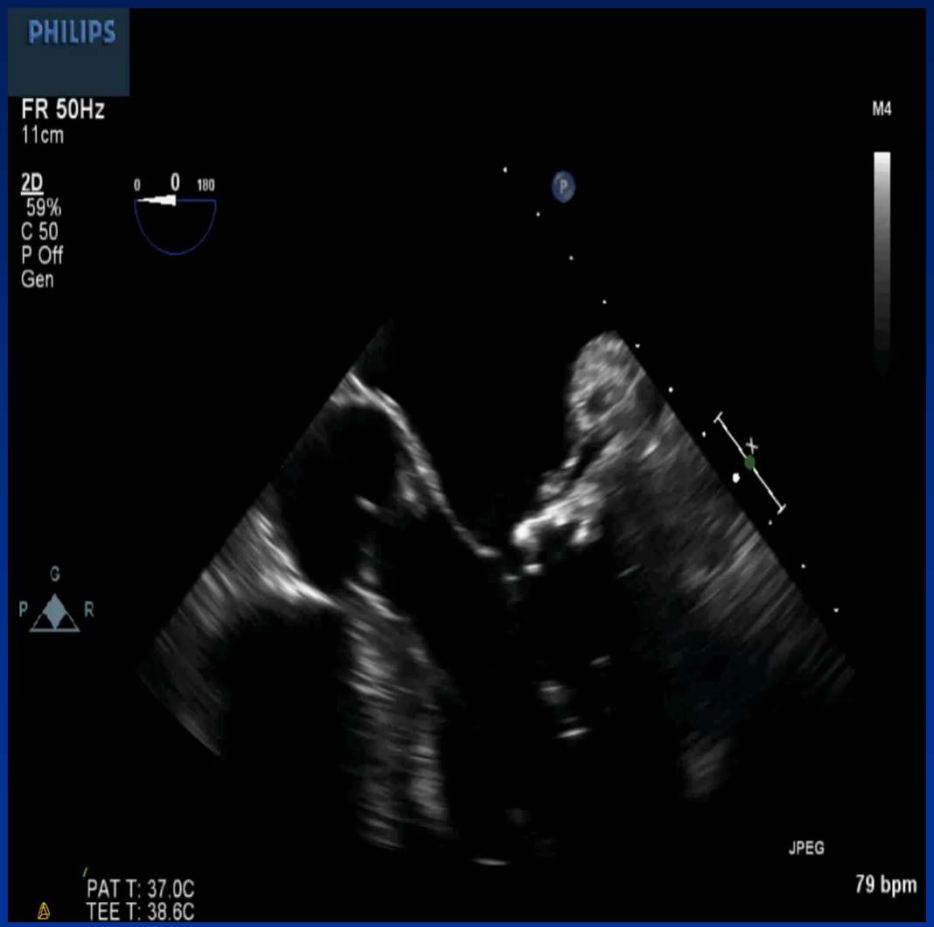
88 bpm
PAT T: 37.0C
TEE T: 40.0C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11cm
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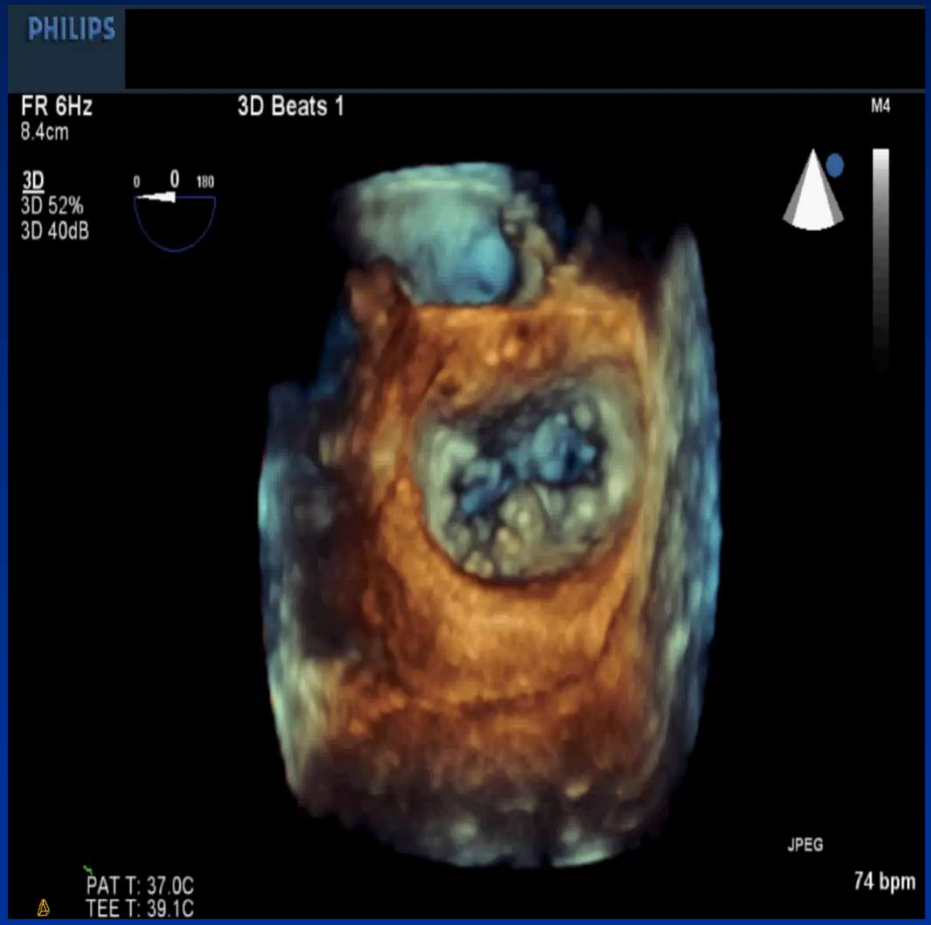
PAT T: 37.0C
TEE T: 38.6C
79 bpm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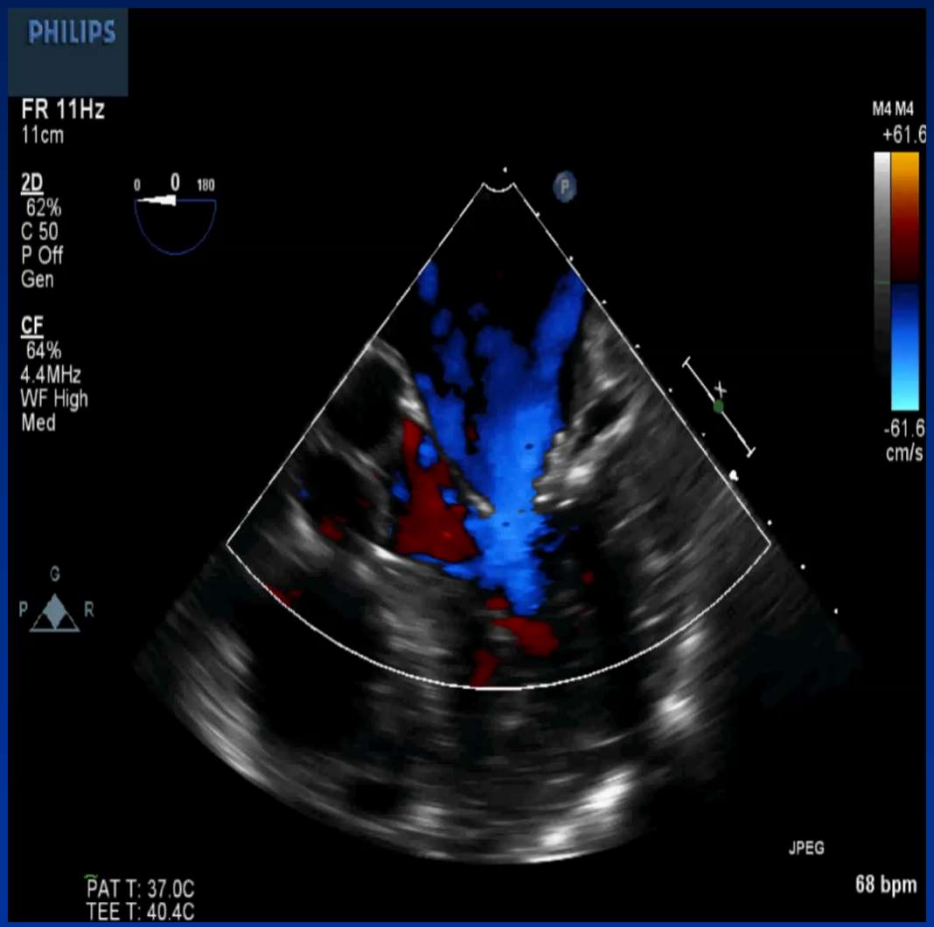
TEE T: 39.1C
74 bpm


PHILIPS
FR 11Hz
11cm
2D
62%
C 50
P Off
Gen
CF
64%
4.4MHz
WF High
Med
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M4 M4
+61.6
-61.6
cm/s
JPEG
68 bpm
PAT T: 37.0C
TEE T: 40.4C

Timing of Surgery

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

Vegetation
Persistent vegetation after systemic embolization
Anterior mitral leaflet vegetation, particularly with size >10 mm*
≥1 Embolic events during first 2 wk of antimicrobial therapy*
Increase in vegetation size despite appropriate antimicrobial therapy*†
Valvular dysfunction
Acute aortic or mitral insufficiency with signs of ventricular failure†
Heart failure unresponsive to medical therapy†
Valve perforation or rupture†
Perivalvular extension
Valvular dehiscence, rupture, or fistula†
New heart block†‡
Large abscess or extension of abscess despite appropriate antimicrobial therapy†

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) w/ 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/^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

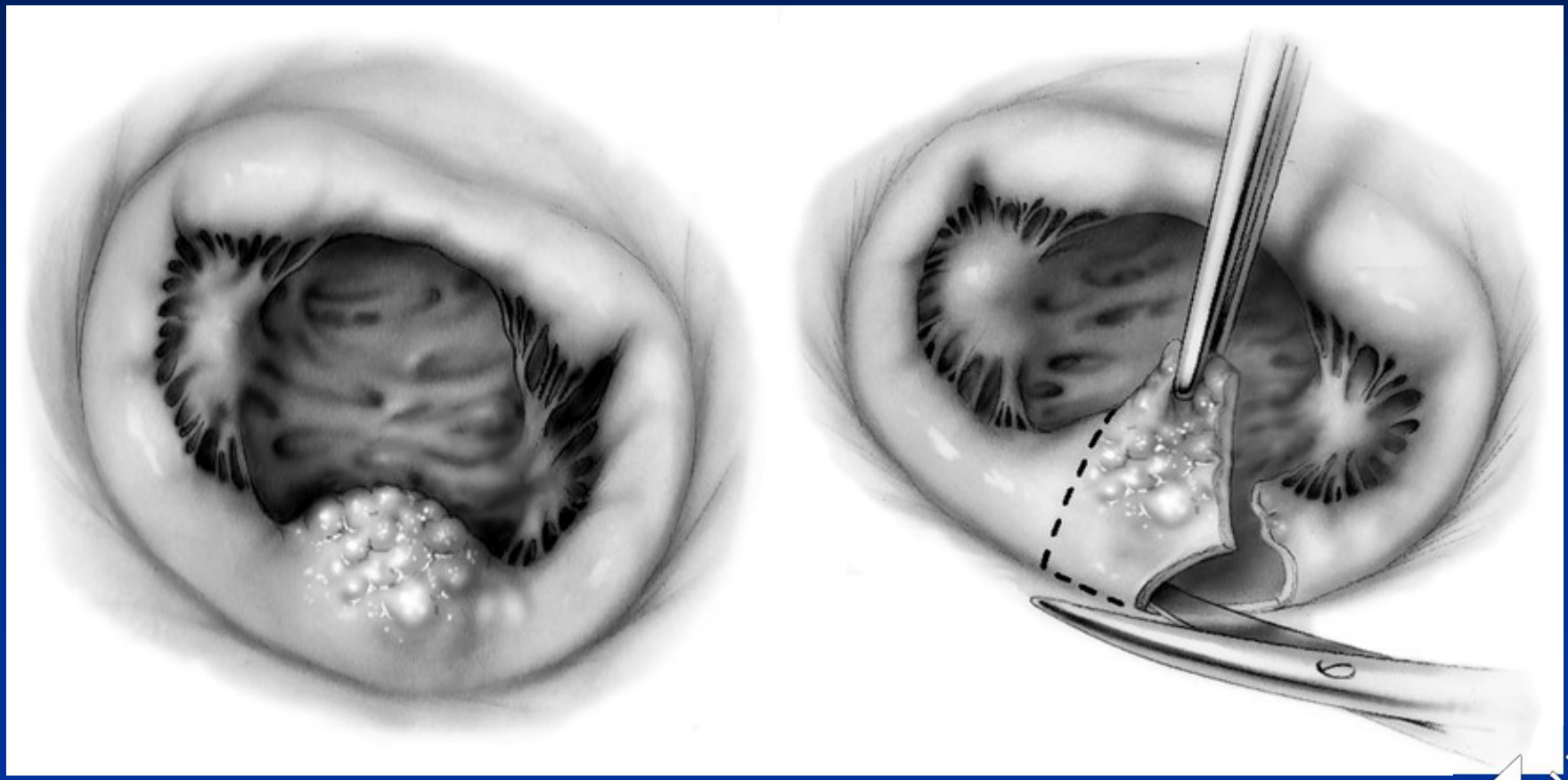
Surgery for Native Valve IE

- Debridement / Resection of all infection
  - Anatomic considerations
    - Coronary anatomy
    - Conduction pathways
    - Septal walls

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

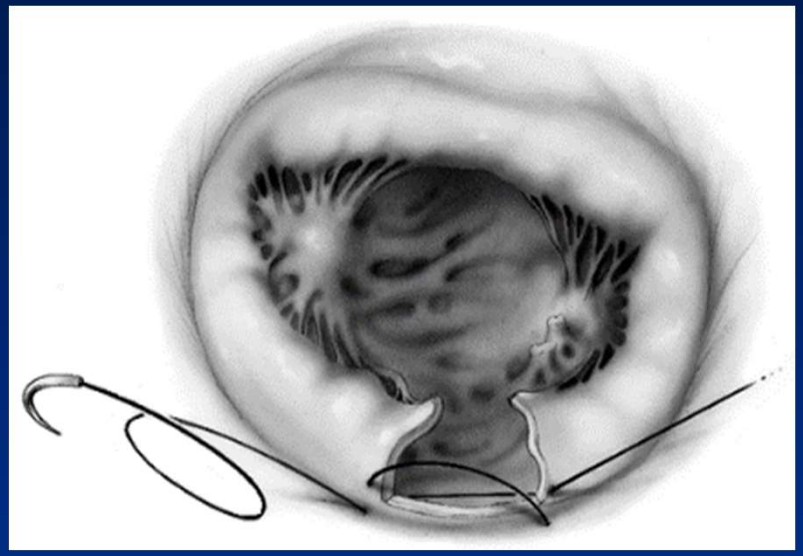
ENDOCARDITIS

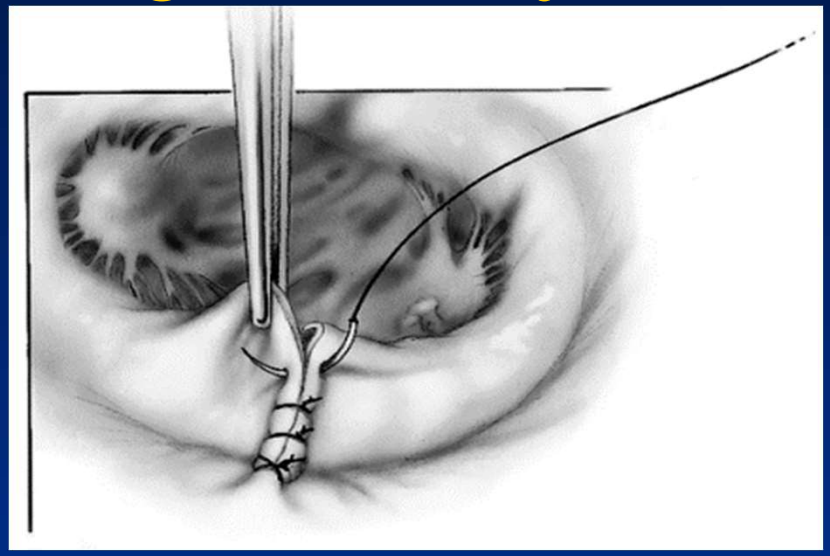
Mitral Valve - Vegetectomy

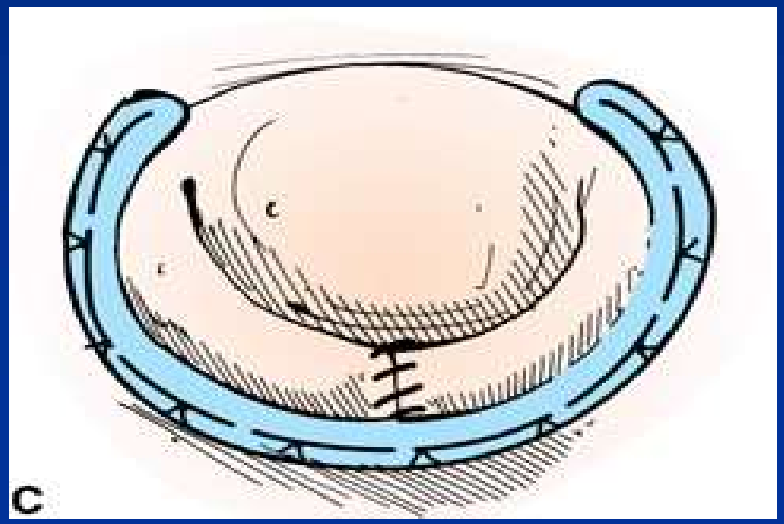


ENDOCARDITIS

Mitral Valve - Vegetectomy

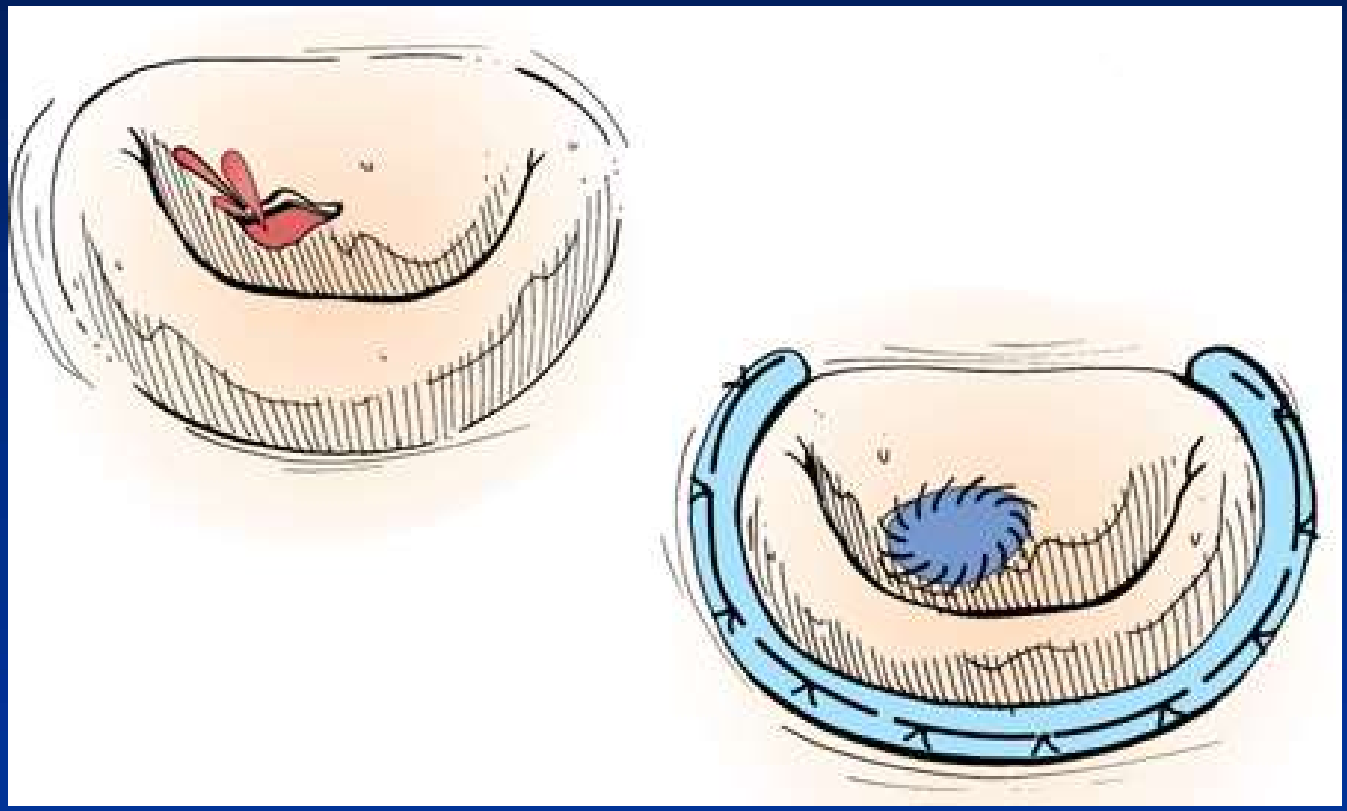






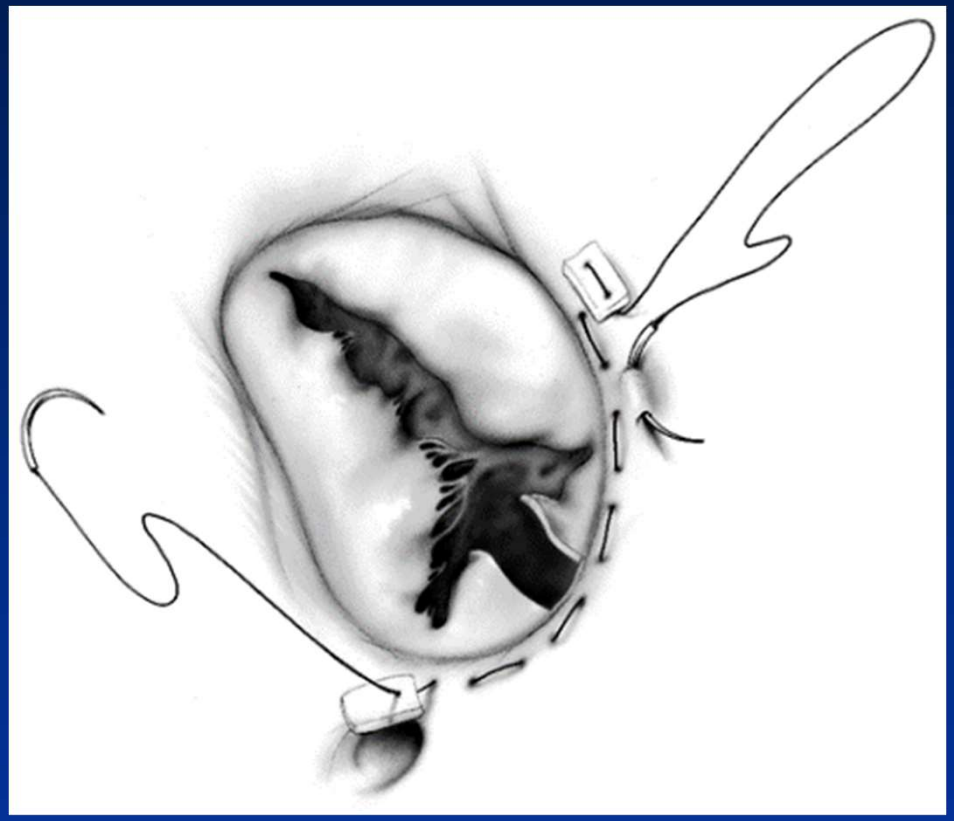
ENDOCARDITIS

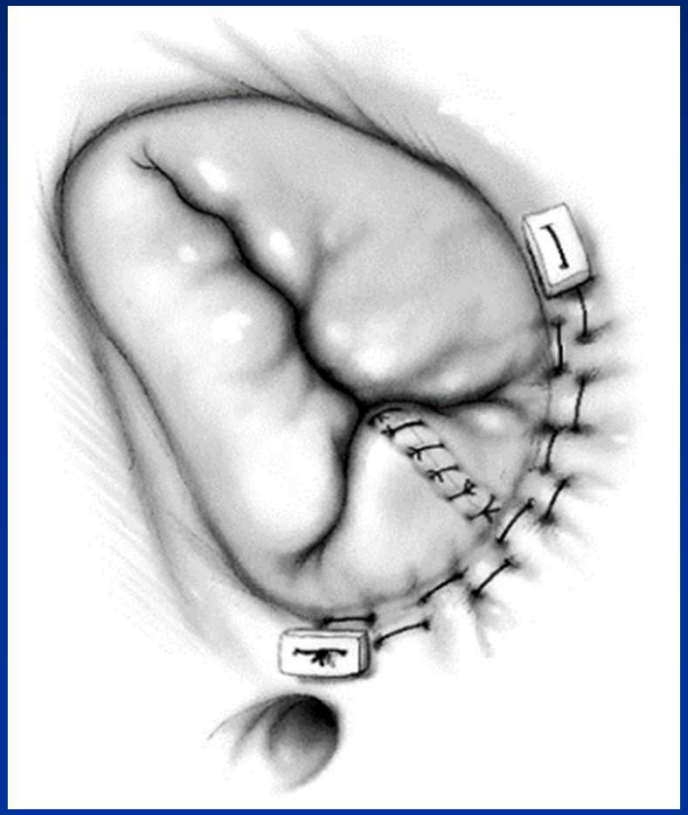
Mitral Valve – Repair of Perforated Leaflet



ENDOCARDITIS

Tricuspid Valve - Vegetectomy





ENDOCARDITIS
Aortic Valve Replacement

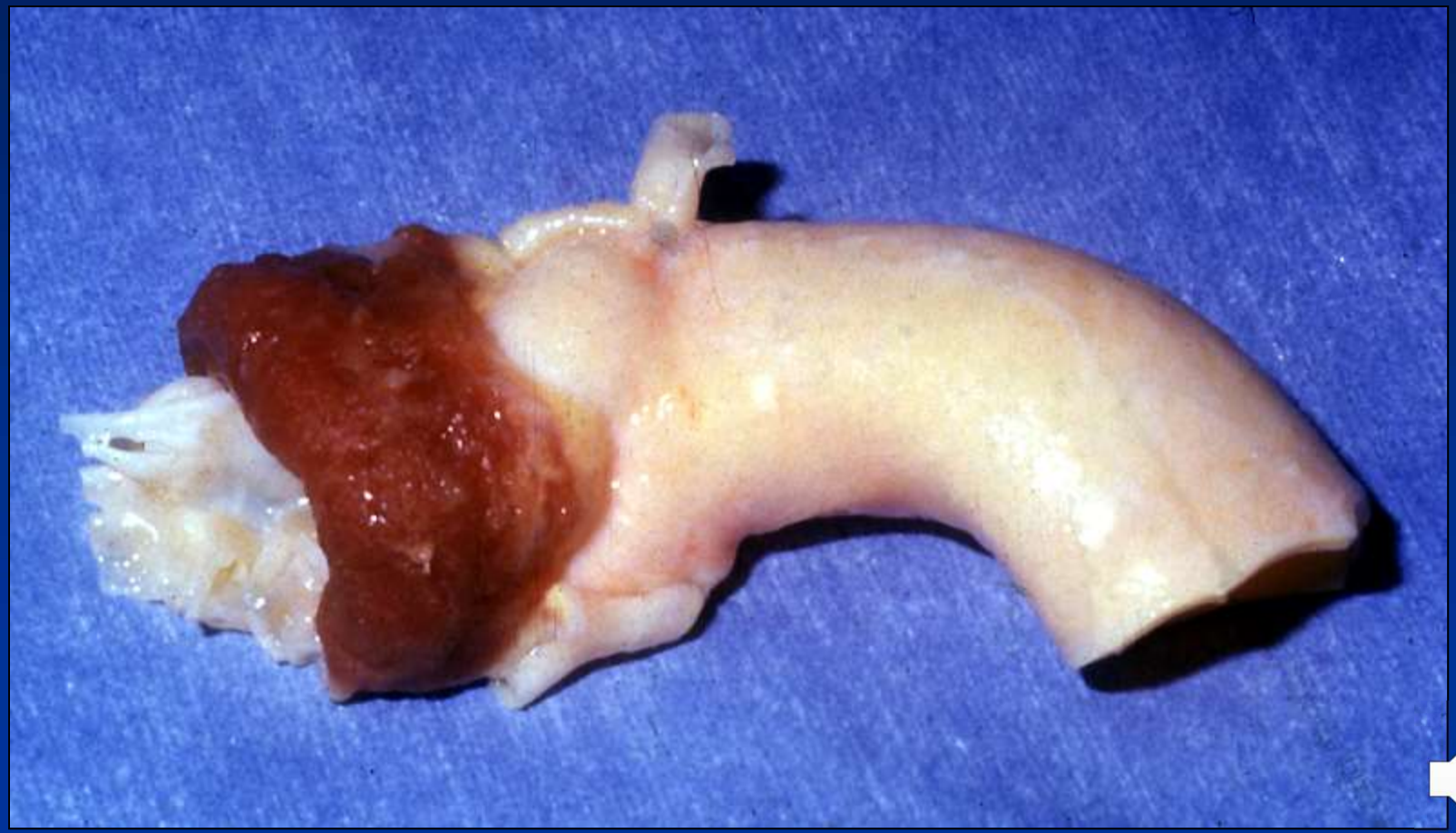
Perimount

Surgery for Prosthetic Valve IE

- Debridement / Resection of all infection
  - Anatomic considerations
    - Coronary anatomy
    - Conduction pathways
    - Septal walls

- 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 Maranic Endocarditis

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

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, mycotic aneurysms
- Neuro: Embolic CVAs, Retinal emboli, mycotic aneurysms
- Hem: Coagulopathies/Anticoagulation Related
- Endo: Adrenal Insufficiency
- ID: Sepsis, Septic Shock, Septic Emboli

Summary

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

- Timing of each component of care is vital
- Specificity & duration of medical therapy is key
- Manage hemodynamics ~ pre & post-op
- Surgery adjusted to the anatomic situation &/or changes

Endocarditis has an increased potential for Multi-System complications over “traditional” open heart surgery and other infectious diseases

Incident Rates of Total Joint Arthroplasties (TJA)

- By 2030, total number of TKAs will increase to 3.48 million/yr
- By 2030, total number of THAs will increase to 572,000/yr
- In addition, shoulder, elbow & ankle arthroplasties are ^ in #'s
- As the total # cases ^, so will the total # of infections

Incident Rates of Periprosthetic Joint Infections (PJI)

- About 1-3% of all primary TJAs
- Up to 3-10% of all revision arthroplasties
- Leading cause of TKA revisions & 3rd leading cause of THA revisions

Healthcare Costs of PJIs

- In 2001, the costs of revision arthroplasties due to infection was about $320 million, ^ to $566 million in 2009, & projected to $1.62 billion by 2020
- Prevention of PJI is therefore imperative
- Presently, the increase in the burden of PJIs is outpacing developments in prevention
- Earlier diagnosis of PJI, followed by appropriate & aggressive surgical treatment can decrease the costs and mortality associated with PJI

Definition of PJI

1. Sinus tract communicating w/ prosthesis[6]; or
2. A pathogen is isolated by culture from 2 or more separate tissue or fluid samples obtained form the affected prosthetic joint[6]; or
3. When 4 of the following 6 criteria exist:

- ^serum erythrocyte sedimentation rate (ESR)[1] & serum C-reactive protein (CRP)[2] concentration,
- ^synovial WBC count[3] or ++ leukocyte esterase test strip[3],
- ^synovial polymorphonuclear percentage (PMN%)[2],
- Presence of purulence* of affected joint,
- Positive histological analysis of fluid/tissue,
- A single positive culture,
- ^synovial C-reactive protein (CRP)[1],
- Positive Synovasure Alpha Defensen[3]

Definition of PJI

Major Criteria

1. Sinus tract communicating w/ prosthesis[6],
2. A pathogen is isolated by culture from 2 or more separate tissue or fluid samples obtained form the affected prosthetic joint[6],

Scoring:
>6 infected
2-5 possible infection
0-1 no infection

Minor Criteria

- Elevated serum erythrocyte sedimentation rate (ESR)[1] & serum C-reactive protein (CRP)[2] concentration,
- Elevated synovial WBC count[3] or ++ leukocyte esterase test strip[3],
- Elevated synovial polymorphonuclear percentage (PMN%)[2],
- Presence of purulence* of affected joint[3],
- Positive histological analysis of fluid/tissue[3],
- A single positive culture[2],
- Synovasure (Positve Alpha Defensin[3] or Elevated synovial C-reactive protein (CRP))[1]

Sinus Tracts

Presentation of PJI

Patient Symptoms

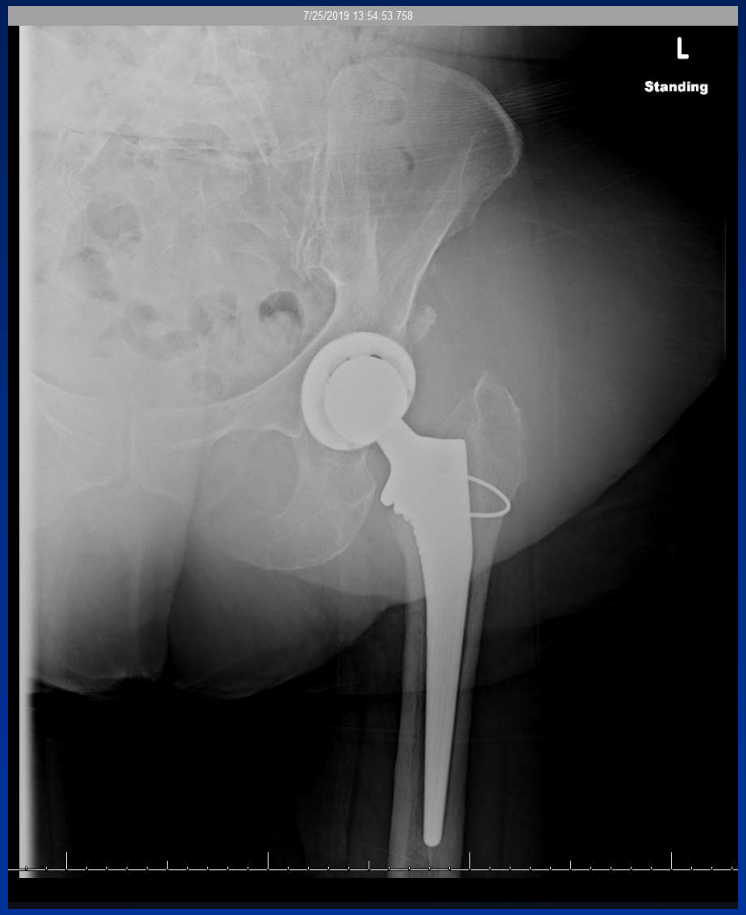
- Pain
- Joint Swelling
- Joint Effusion
- Impaired ROM
- “It just doesn’t feel right”
- ”It just doesn’t look right”
- Less common: fever, chills, leukocytosis*

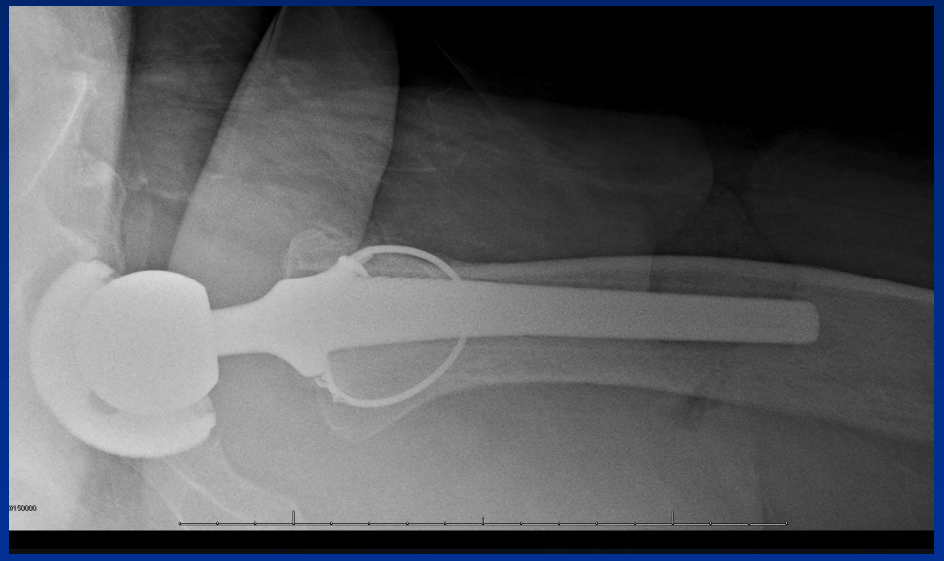
Radiology

- Loosening/subsidence of implants
- Periprosthetic lucency
- Periprosthetic fracture
- Periosteal new bone formation

Prosthetic Joint Infections

Prosthetic Joint Infections





Risk Factors

- Obesity, esp BMI over 40
- Low BMI, <25
- Diabetes
- Rheumatoid arthritis
- Immunosuppression
- Malignancy
- Chronic renal failure
- Revision surgery
- Early post op issues (hematoma, SSI, drainage, wound dehiscence, need for transfusion)

Revision Arthroplasty: Reasons for Aseptic Failure

- Loosening @ the bone-cement interface
- Periprosthetic fracture
- Fracture of prosthetic material itself
- Wear
- Implant malposition
- Dislocation-instability
- Materials fatigue

When planning for & performing revision surgery, you must rule out infection

Classification of PJI

- Stage 1/early: symptoms start w/in first 4 to 8 wks post op
- Stage 2/delayed: presents 3 – 24 mons post op*
- Stage 3/late: more than 24 mons post op
- Stage 4/silent: a condition in which a positive culture is captured @ the time of revision in asymptomatic patient

- Early>usually virulent organism (S. aureus)
- Late>usually hematogenous
- Silent>low-virulence organisms (coag neg staph, propionbacterium acnes)

Treatment of PJI

- **Gold Standard**: 2-stage exchange. Resection of implants, placement of temporary antibiotic-impregnated cement spacer, 6 wks of IV antibiotics & delayed component reimplantation
- Irrigation & *aggressive* debridement>acute onset of symptoms, implants well-fixed & aligned, antibiotic-susceptible organism & sufficient soft-tissue coverage
- Goals of surgery: eradicate infection, restore pain-free function & minimize PJI-related morbidity

Antibiotic-impregnated cement spacer

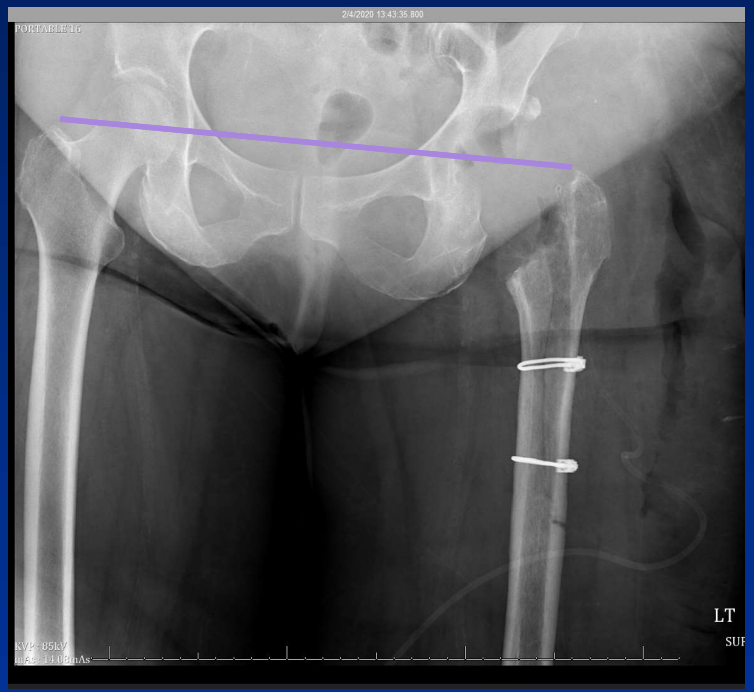
Role of Biofilm

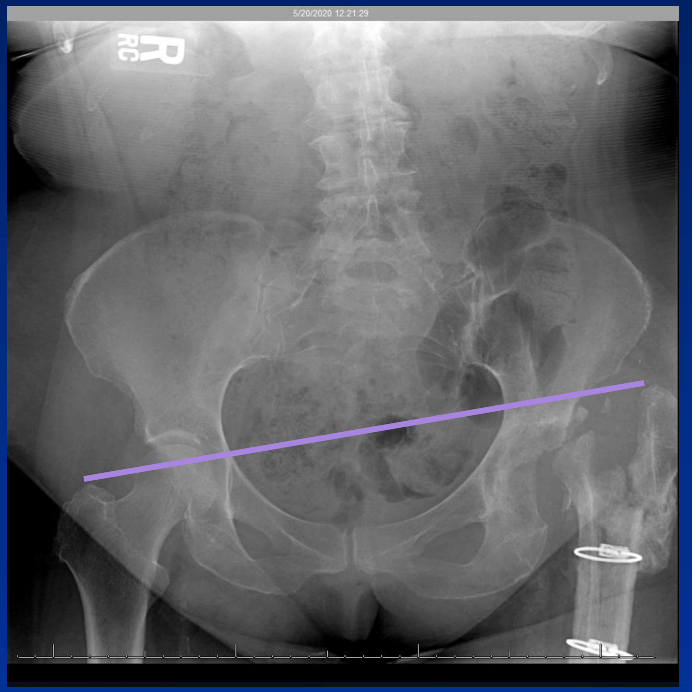
- Complex communities of microorganisms embedded in an extracellular matrix that forms on surfaces
- Extracellular matrix is composed of polysaccharides, proteins and/or extracellular DNA
- Bacteria within biofilm is protected from antimicrobials & the host immune system
- Biofilm forms on joint prosthesis
- Surgical removal of prosthesis is mandated in order to achieve a cure

Inability to eradicate infection

- Re-implantation of implants followed by life-long antibiotic suppression therapy
- Resection of implants without re-implantation (hip>resection arthroplasty)
- Amputation (knee-AKA, hip-disarticulation)

Prosthetic Joint Infections

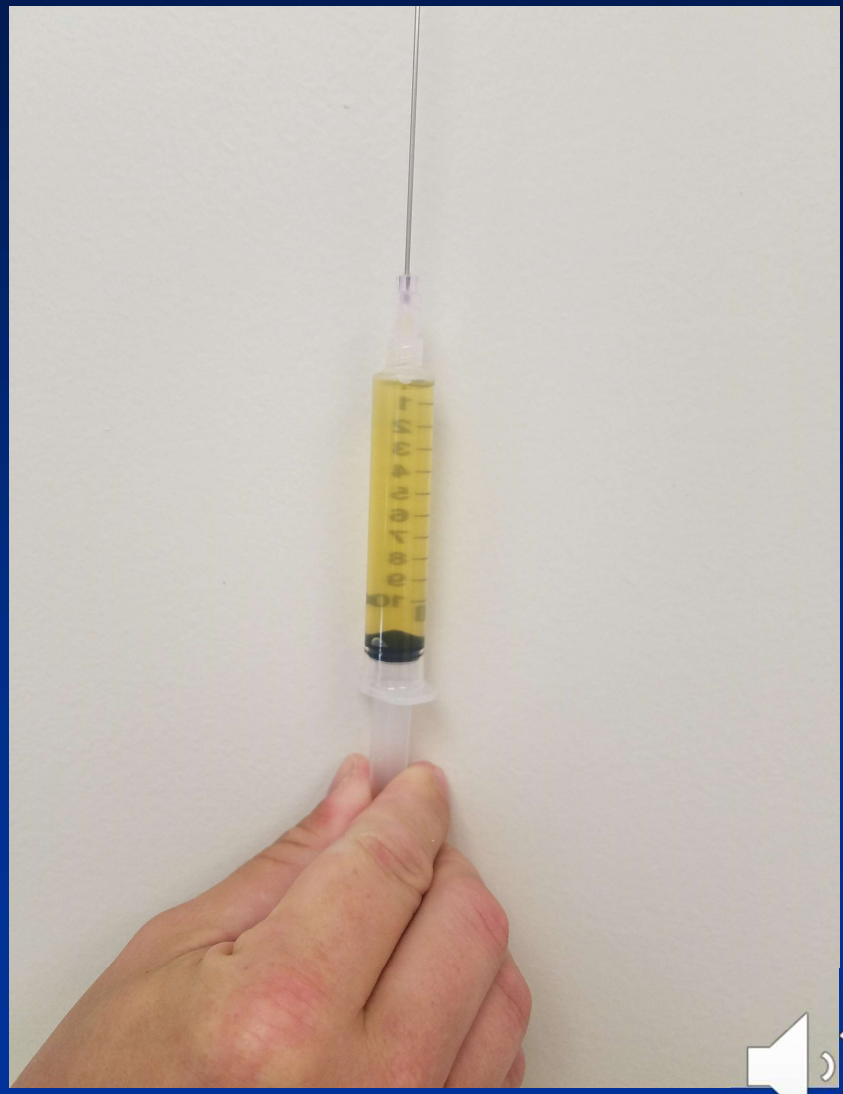




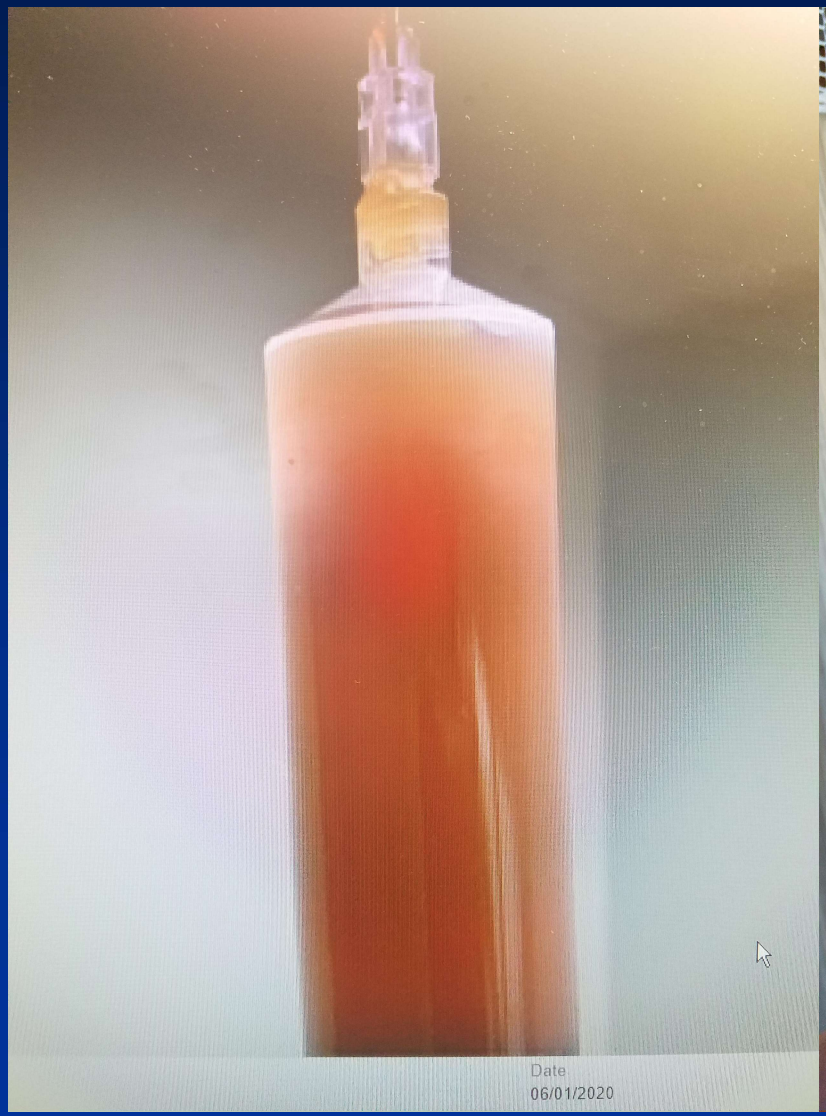
What to do if you suspect a PJI

- If patient has painful TKA/THA > 1 yr after surgery, obtain XRs & Serology* (ESR/CRP)
- If TKA/THA feels loose, unstable or “just doesn’t feel right”, obtain XRs & Serology
- If HW on XRs reveals loosening, subsidence, debonding, obtain serology & do aspiration (knee>in clinic, hip>in OR)
- Refer to a total joint trained surgeon

Joint Aspiration



Joint Aspiration



Endocarditis & Prosthetic Joint Infections: Similarities & Differences

	IE	PJI
Initial presentation	Subtle>>>obvious	Subtle, less so obvious
Sepsis, SIRs, Shock	More likely	Unlikely
Initial Practice Location	=	=, but can be Ortho
Est. Diagnostic Criteria	Yes	Yes
Criteria Followed	More likely	Less likely
Equal Surgical Expertise	More likely	Less likely
Mortality	Higher	Lower
Morbidity	Higher	Lower but not by much
High Health Care Costs	=	=
Prevalence	Going up	Staying same
Cases w/ neg culture	~10%	~2-18%
Episode of care	Typically short	Typically prolonged
Eradication w/ surgery	Yes, less in recurrent IVDA	Yes, lower if Rx delayed
Bad to have	=	=

Endocarditis & Prosthetic Joint Infections: Similarities & Differences

	IE	PJI
Initial presentation	Can be subtle then obvious	Subtle, can be obvious
Sepsis, SIRs, Shock	More likely	Unlikely
Initial presentation location	=	= more likely Ortho
Established diagnostic criteria	Yes	Yes
Criteria followed	More likely	Sometimes less likely
Mortality	Higher	Lower
Morbidity	Higher	Lower, but not by much
High health care costs	Yes	Yes
Prevalence	Going up	Staying same
Culture negative cases	~10%	~2-18%
Episode of care	Typically, short	Typically, long
Eradication w/ surgery	Yes, less so w/ recurrent IVDA	Yes, lower if treatment delayed

Endocarditis & Prosthetic Joint Infections

- Cases of infectious endocarditis and prosthetic joint infections carry significant morbidity
- Both conditions have many similarities, yet some obvious differences
- Both conditions require promote diagnosis, proper treatment and appropriate consultation(s)