Infection of Tunneled Central Venous Catheter for Hemodialysis : When Should an Infected Catheter Be Removed or Changed ?

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CONTROVERSIES & UPDATES IN VASCULAR SURGERY

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Disclosure

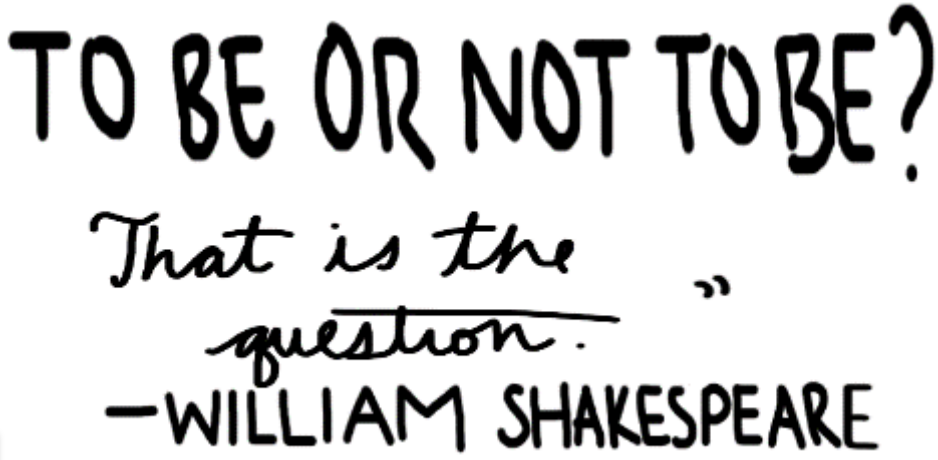
Speaker name: **Prof. Bernard Canaud**

- ☐ I have the following potential conflicts of interest to report:
- ☐ Consulting
- ☒ **Employment in industry (FMC)**
- ☐ Shareholder in a healthcare company
- ☐ Owner of a healthcare company
- ☐ Other(s)
- ☐ I do not have any potential conflict of interest

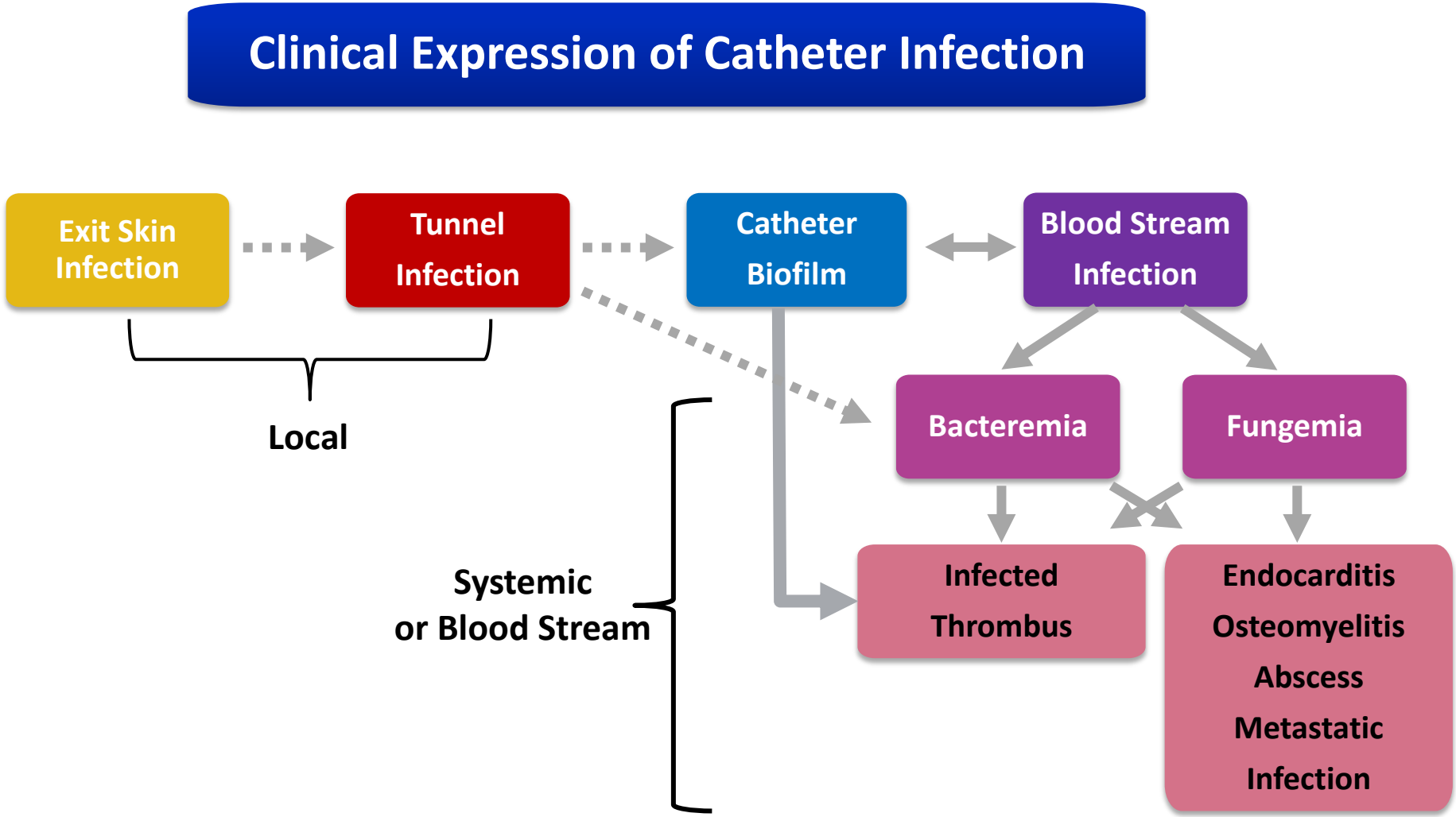
FRESENIUS MEDICAL CARE

Facing Infection of Tunneled Central Venous Catheter for Hemodialysis : To Remove or Not To Remove the Catheter ?

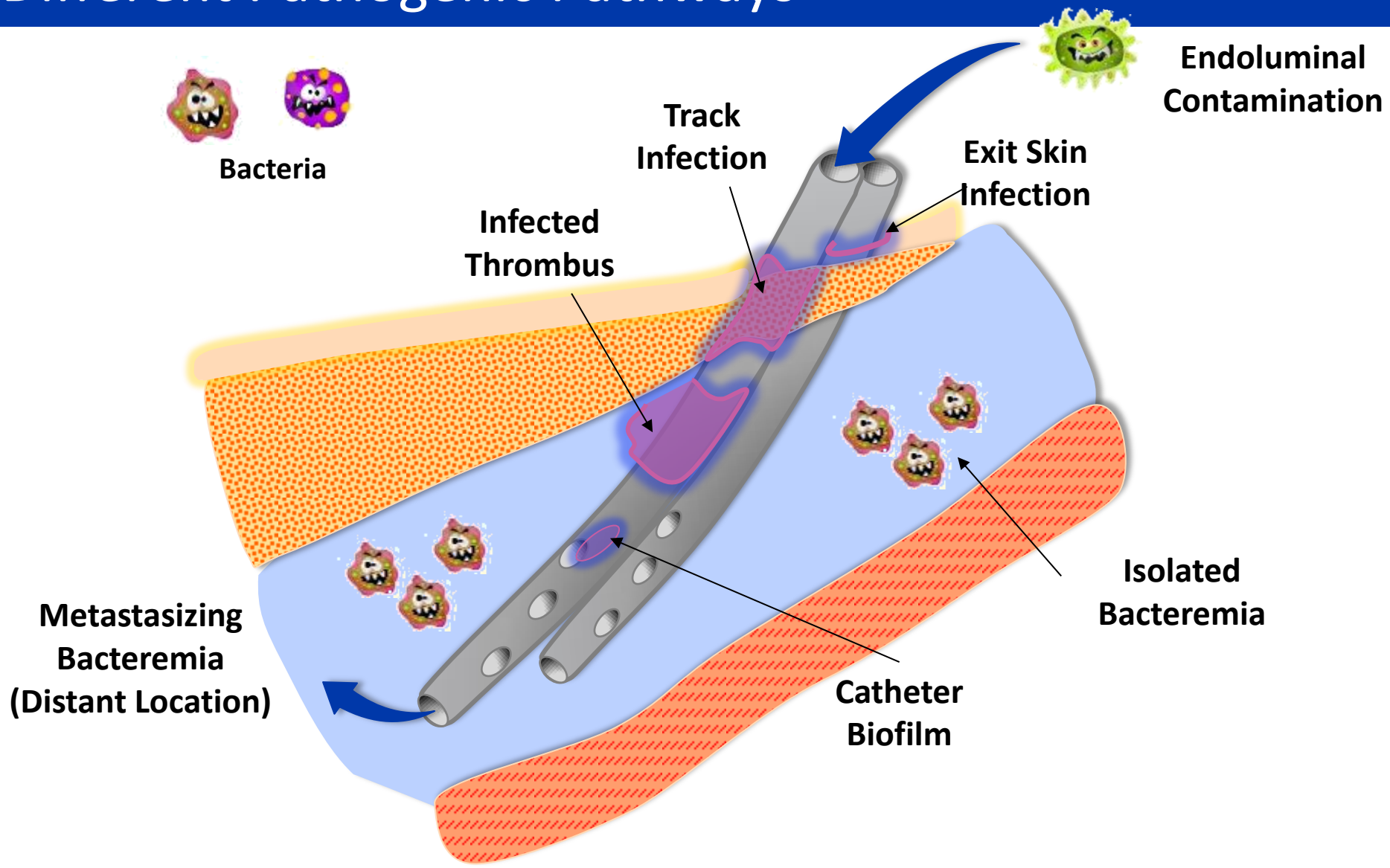
CONTROVERSIES & UPDATES IN VASCULAR SURGERY



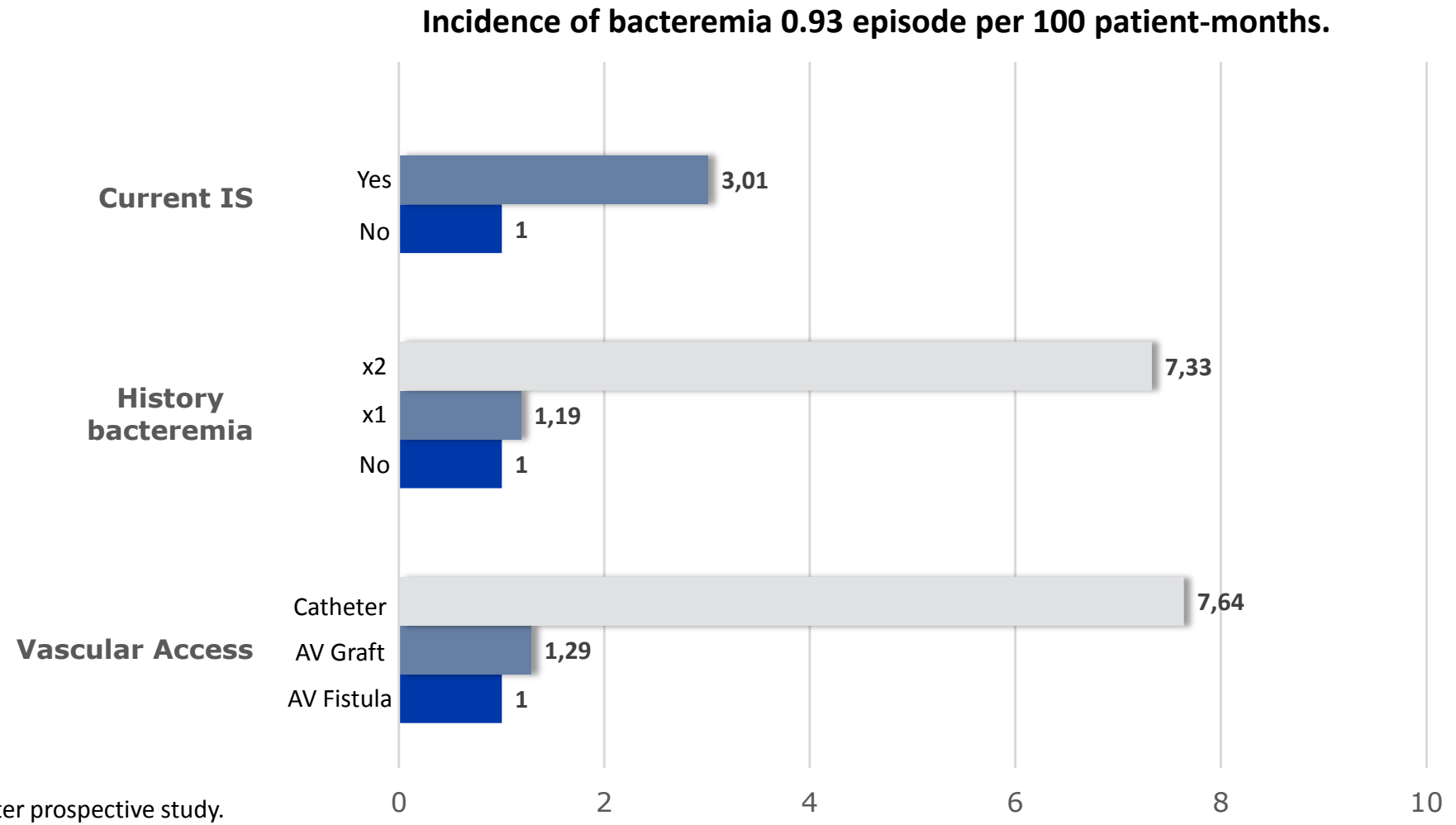
What Is a Central Venous Catheter Infection ?



Catheter-Related Infections in Hemodialysis Patients:
Different Pathogenic Pathways



Incidence of Bacteremia is Increased in Patients Bearing Catheters

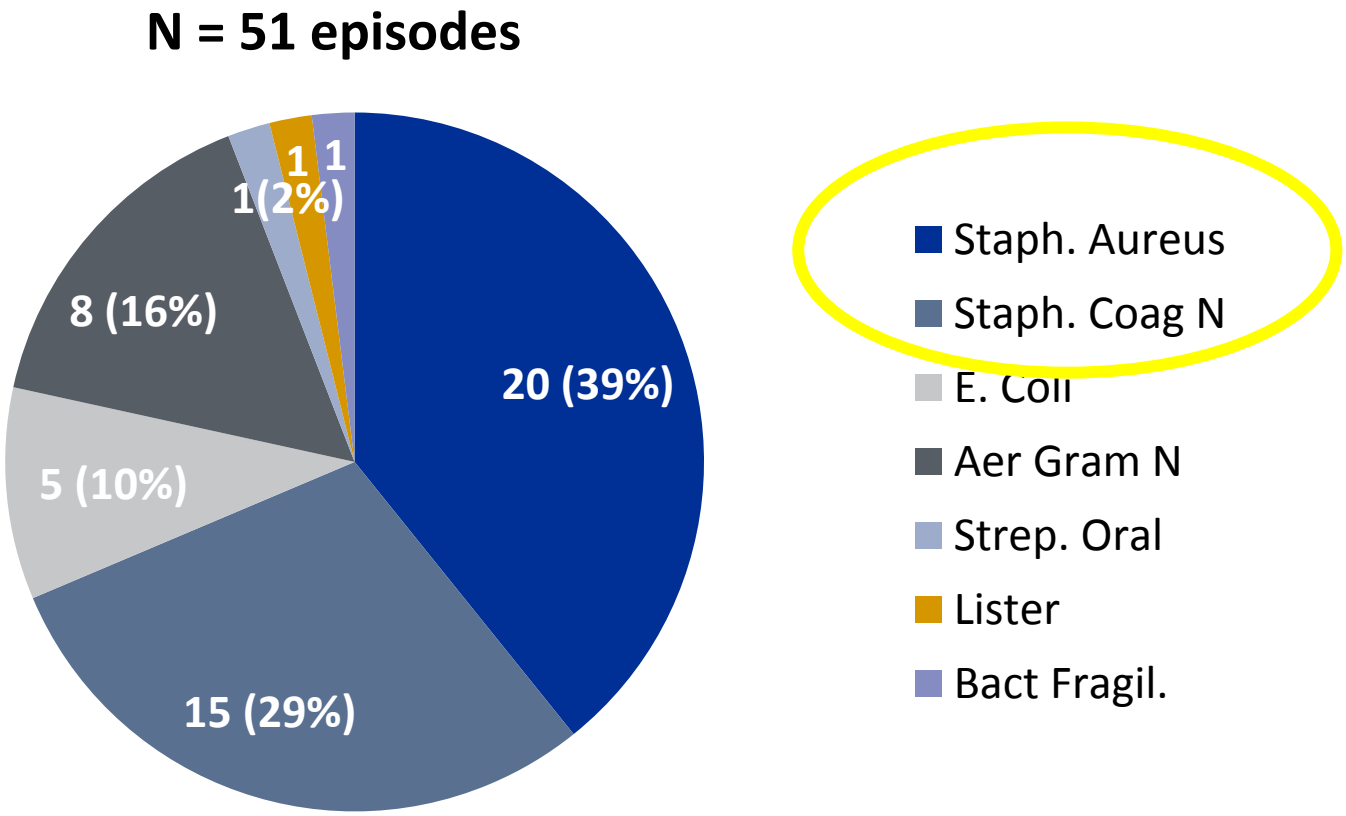


Multicenter prospective study.
Incidence and risk factors for bacteremia in chronic HD pts.
988 adults on chronic HD followed up for 6 mo in 19 HD units.

Hoen B et al. *J Am Soc Nephrol.* 1998; 9:869-876

Repartition of Microorganisms

Incidence of bacteremia 0.93 episode per 100 patient-months.



Multicenter prospective study.
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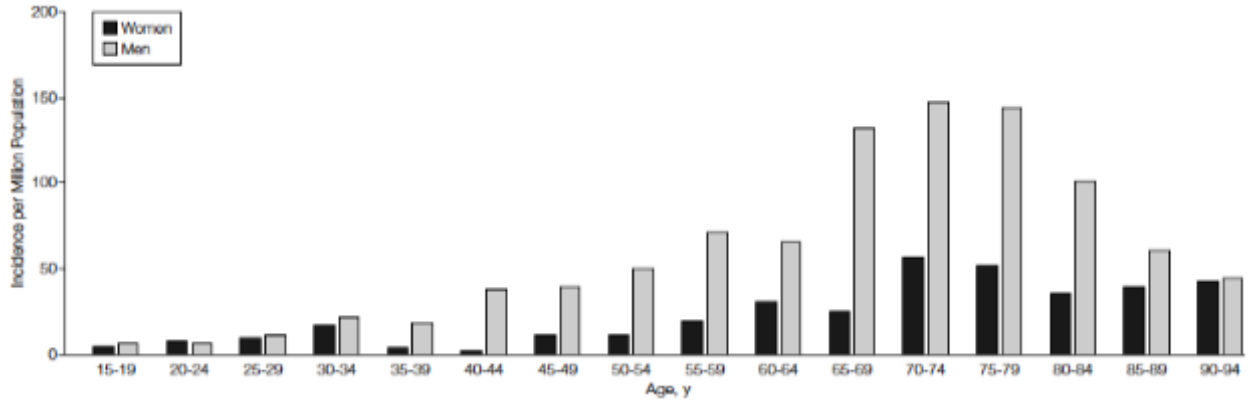
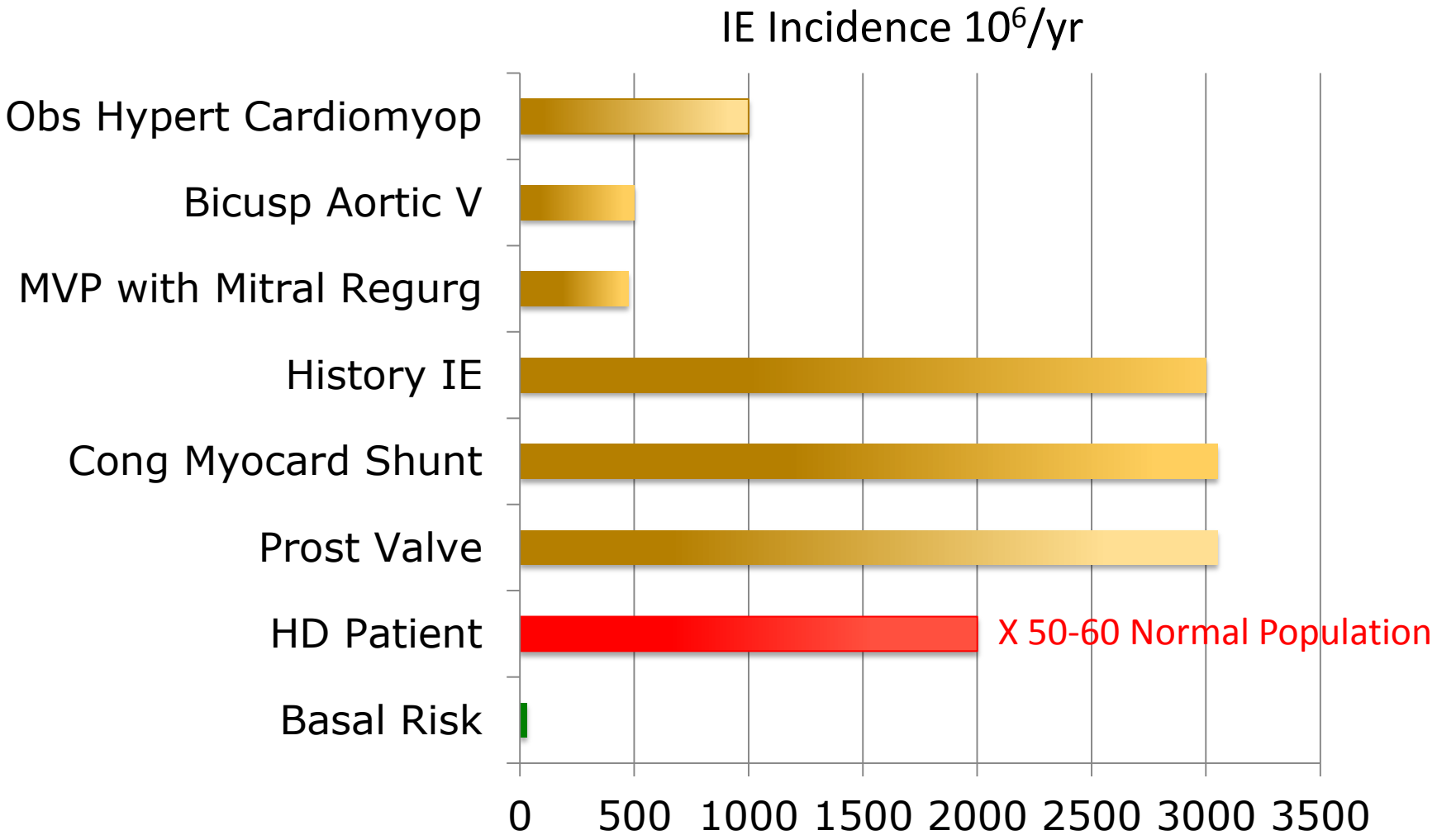
Infective Endocarditis:
Results of a 1-Year Survey in France

- Retrospective study (Jan. 1, 1999 – Dec. 31, 1999)
- 6 French regions (16 millions inhabitants)
- Infective endocarditis confirmed Duke criteria (echocardiography &microbiology)
- 390 patients 277 M / 113 F (mean age : 59±17 yrs)
- **Crude annual incidence 30 cases/yr/pmp**
- **Increased with age & peaked after 70 years old**



Hoen B et al. *JAMA* 2002; 288:75-81

Risk Factors of Developing Infective Endocarditis



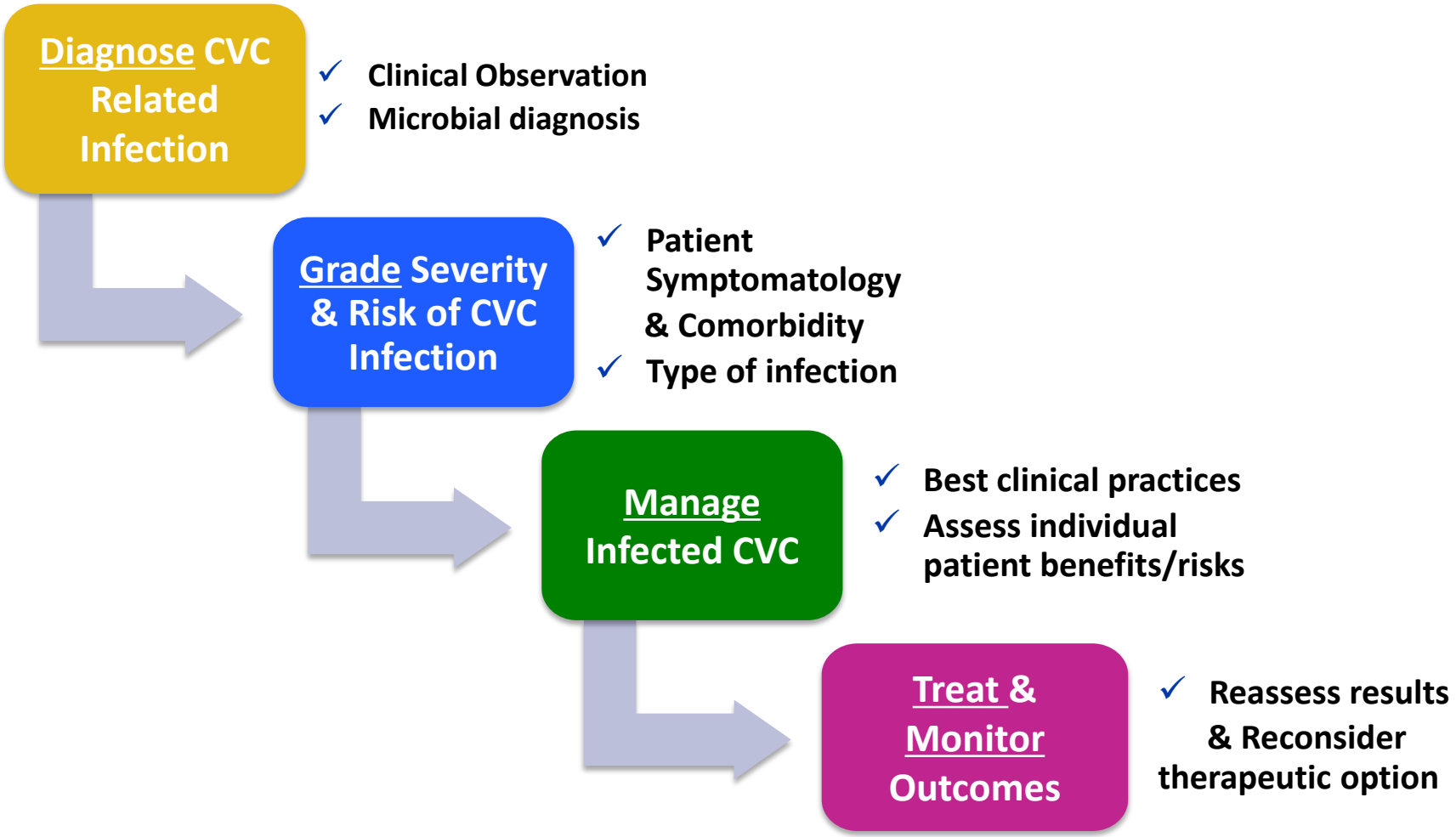
Hoen B et al. *JAMA* 2002; 288:75-81

Infective Endocarditis is Associated with High Mortality in HD Patients

	Nori *et al.*	Spies *et al.*	Doulton *et al.*	Maraj *et al.*	McCarthy and Steckelberg
Episodes of IE in series	*n* = 54	*n* = 40	*n* = 30	*n* = 30	*n* = 17
Mortality rate					
Inhospital	37%	52%	30%	25%	45%
1-year			46%	56%	75%

Hoen B et al. *JAMA* 2002; 288:75-81

Algorithm Approach to Manage CVC-Related Infection: Best Clinical Practices



Diagnosing CVC-Related Infection

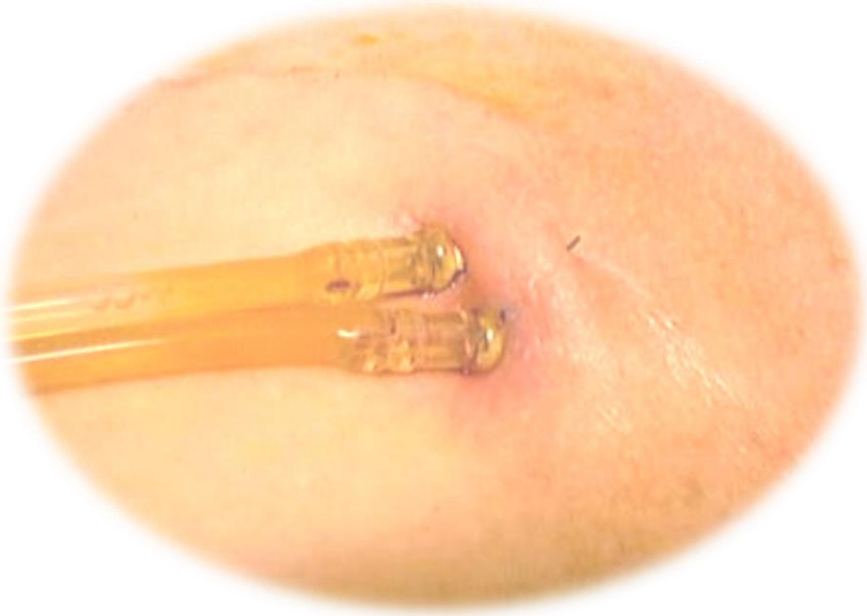
- Clinical observation
  - Presence of local or systemic symptoms
  - Clinical vigilance and monitoring of CVC
- Microbial infection diagnosis
  - Identifying pathogenic microorganism(s)
    - Swab and culture skin exit exudate and catheter hub
    - Blood culture through catheter is recommended
    - Quantitative and qualitative Gram staining
    - Microorganism determination and antibiotic testing
  - Confirming the pathogenic link catheter-bacteremia
    - Blood culture (and catheter clot) through catheter
    - Blood culture (x2 recommended) via peripheral phlebotomy
    - Concordance of at least one microorganism in both culture

Normal Skin Aspect with DualCath

Exit Site Infection of DualCath :

Inflammatory and Abscess

Inflammatory



Abscess

Tract and Tunnel Infection

Tunnelitis

Grading Severity of CVC-Related Infection

Catheter Related Infection

Catheter Related Blood Stream Infection

- Un-Complicated
- Complicated
- Risk
- Micro-organism

Grading Severity of CVC-Related Infection

Un-Complicated

- ✓ Skin exit infection
- ✓ No fever
- ✓ No systemic reaction
- ✓ Low CRP
- ✓ Low leukocyte
- ✓ Negative blood culture
- ✓ No risk factor
- ✓ Favorable microorganism type

Complicated

- ✓ Tunnel infection
- ✓ Sepsis
- ✓ Positive blood culture x2
- ✓ Persisting, Relapsing, rapid deterioration
- ✓ Septic metastasis, endocarditis, osteomyelitis
- ✓ Septic thrombosis

Risk

- ✓ Cardiomyopathy
- ✓ Valvulopathy
- ✓ Medical device
- ✓ Valve prosthesis
- ✓ Elderly
- ✓ Diabetic
- ✓ Immunosuppression
- ✓ History of bacteremia
- ✓ Infective endocarditis …

Micro-organism

- ✓ Coagulase Negative Staphylococcus
- ✓ Staphylococcus Aureus
- ✓ Enterococcus
- ✓ Gram Negative Bacilli
- ✓ Pseudomonas Aeruginosa
- ✓ Candida spp.
- ✓ Other

Microbial and Laboratory Monitoring

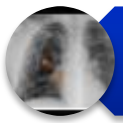
- Blood cultures
  - Through catheter (with and without fibrinolytic)
  - Catheter clot culture
  - Peripheral phlebotomy
- Swab culture and Gram stain
  - Skin exudate
  - Catheter hub, pavilion, connection
- Catheter cultures when CVC is removed
- Leukocyte count
- CRP, Fibrinogen
- Procalcitonin …

Imaging Dialysis CVC Infection

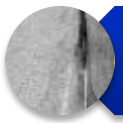

Clinical observation & picture

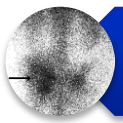

Echography: Tunnel sonography, Phlebitis


Echocardiography

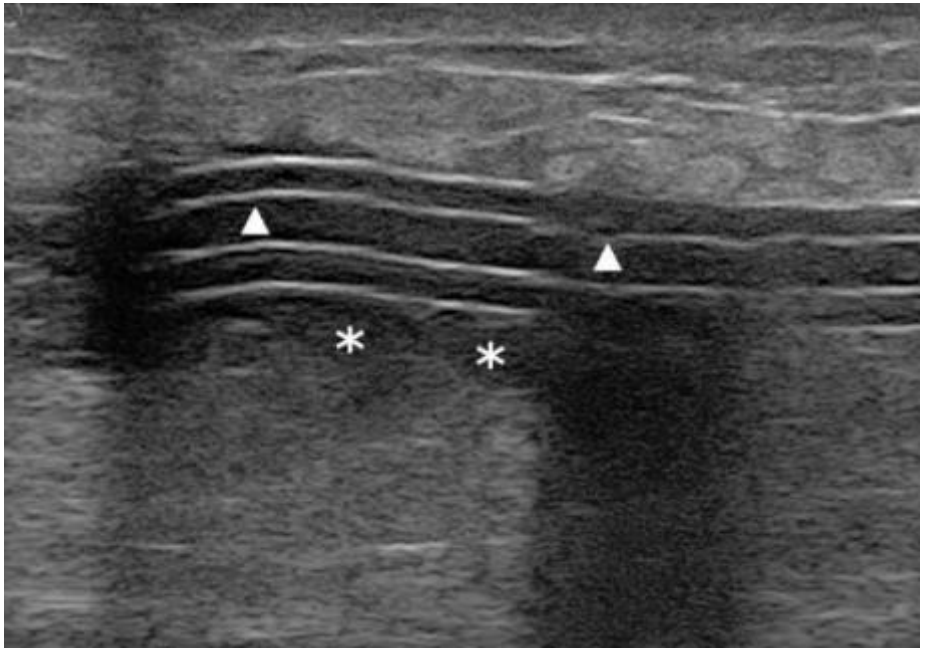

Chest X-Ray

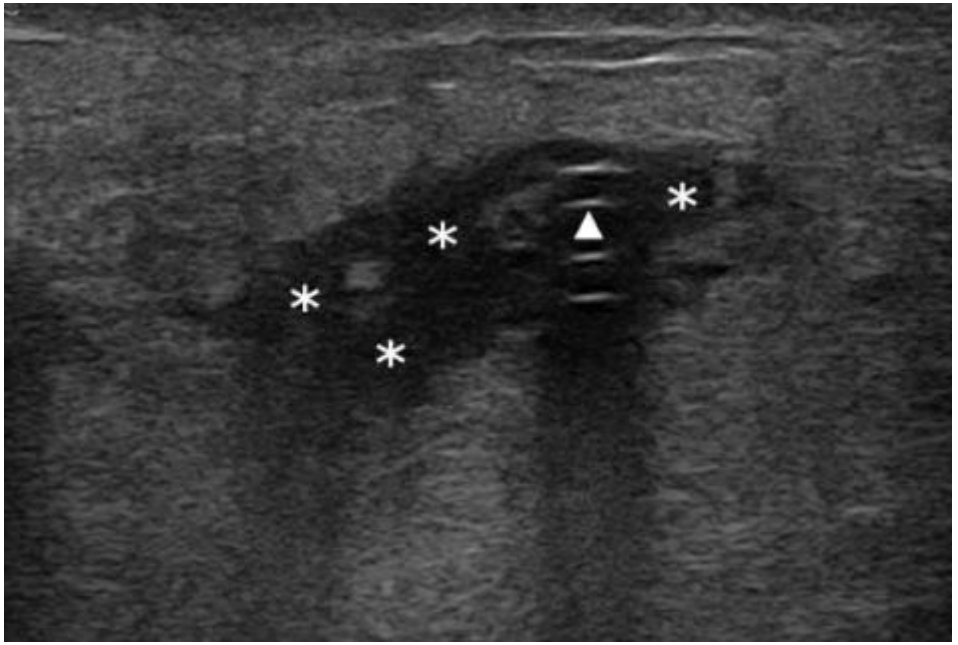

CT Scan


Catheterogram – Phlebography


Isotopic

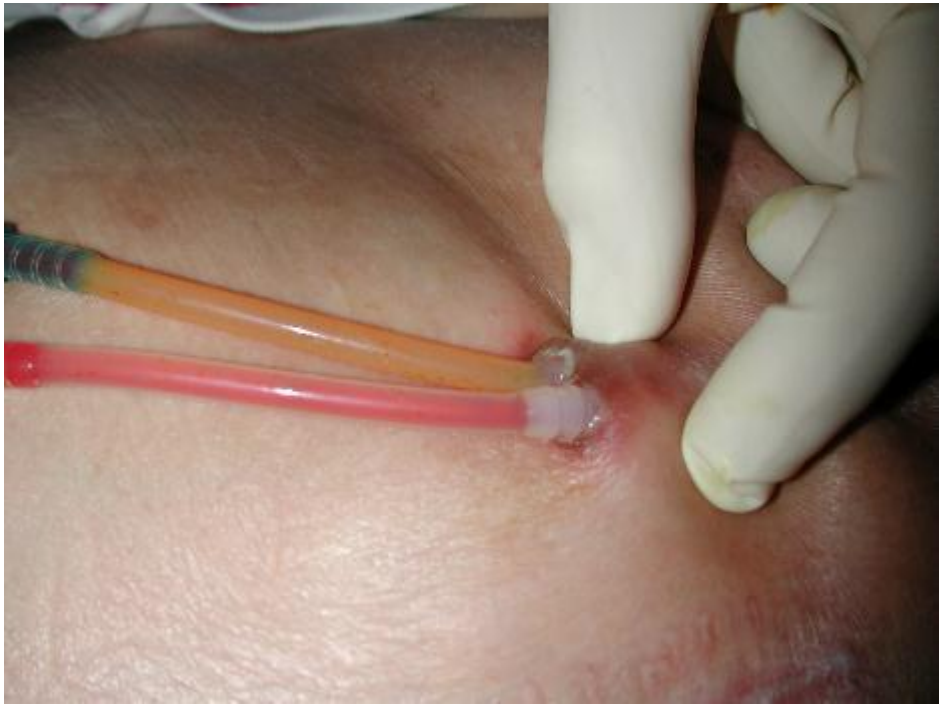
Tunnel Infection with Abscess Formation

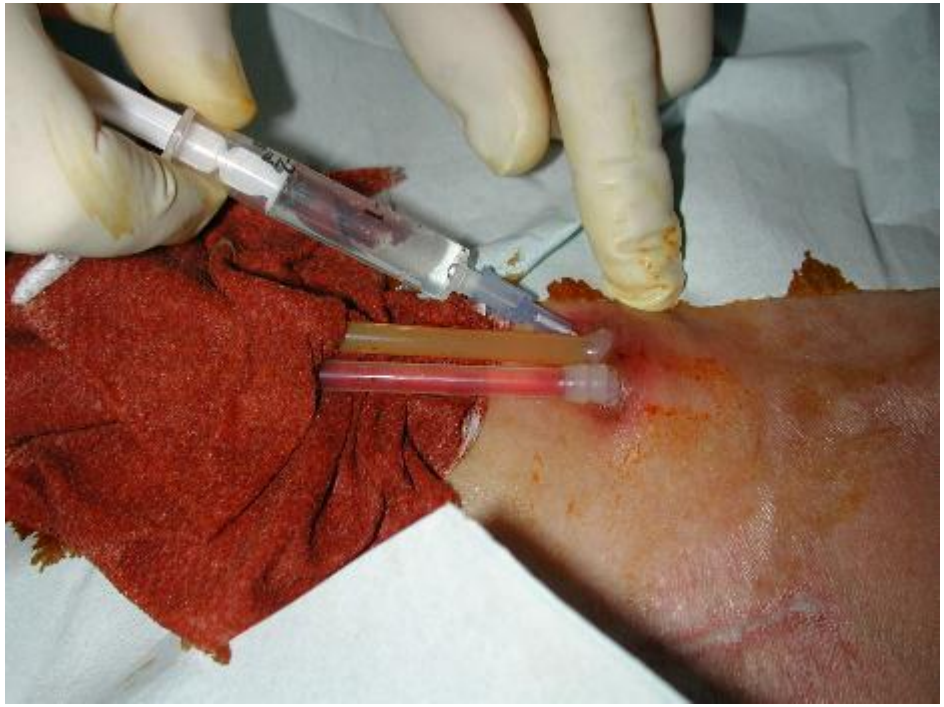




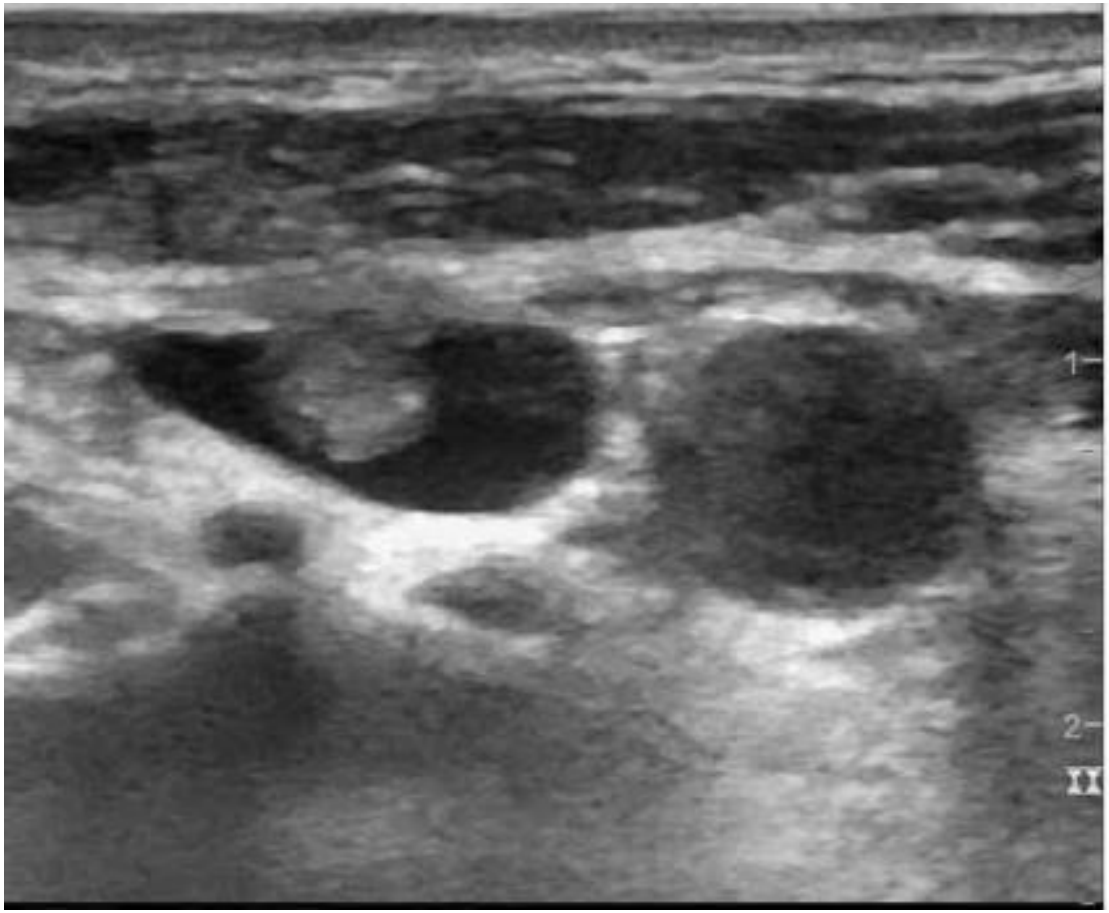
Exit Skin Infection with Abscess:

Local Drainage and Local Antibiotic Lavage



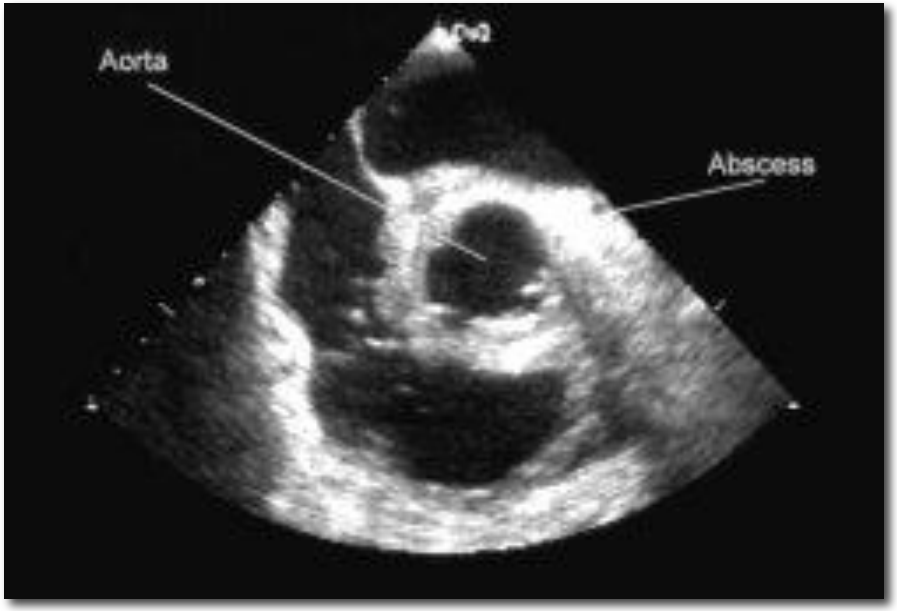


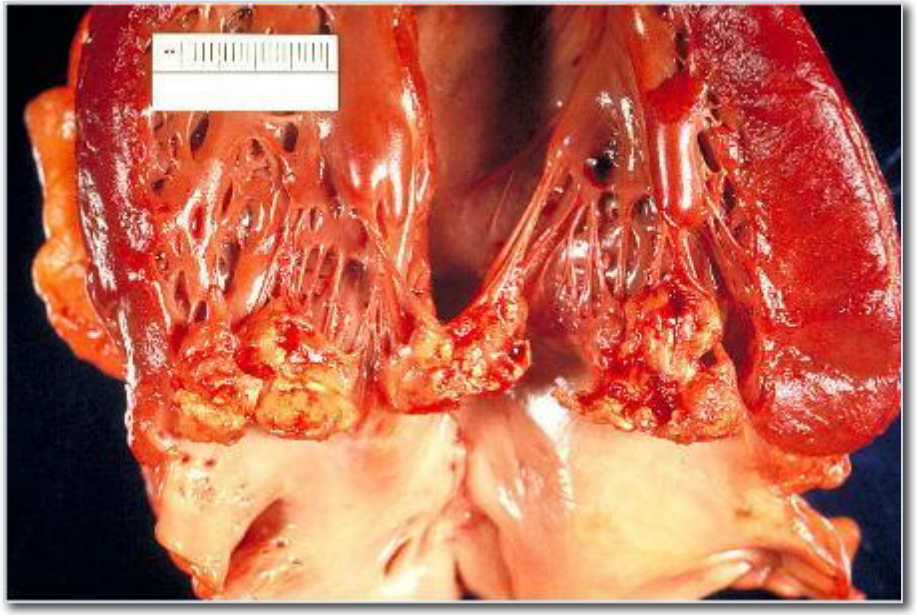
Infected Thrombus of IJV Due to CVC



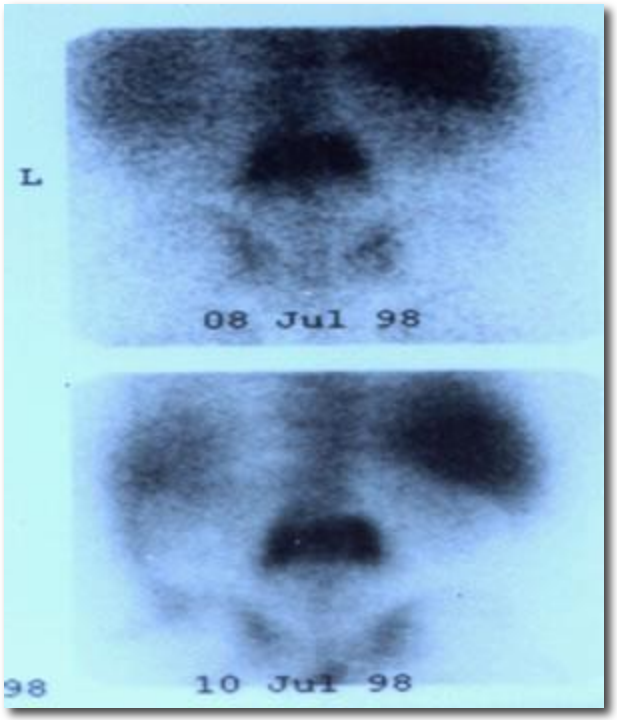
Mitral Endocarditis with Abscess Due to CRBSI:

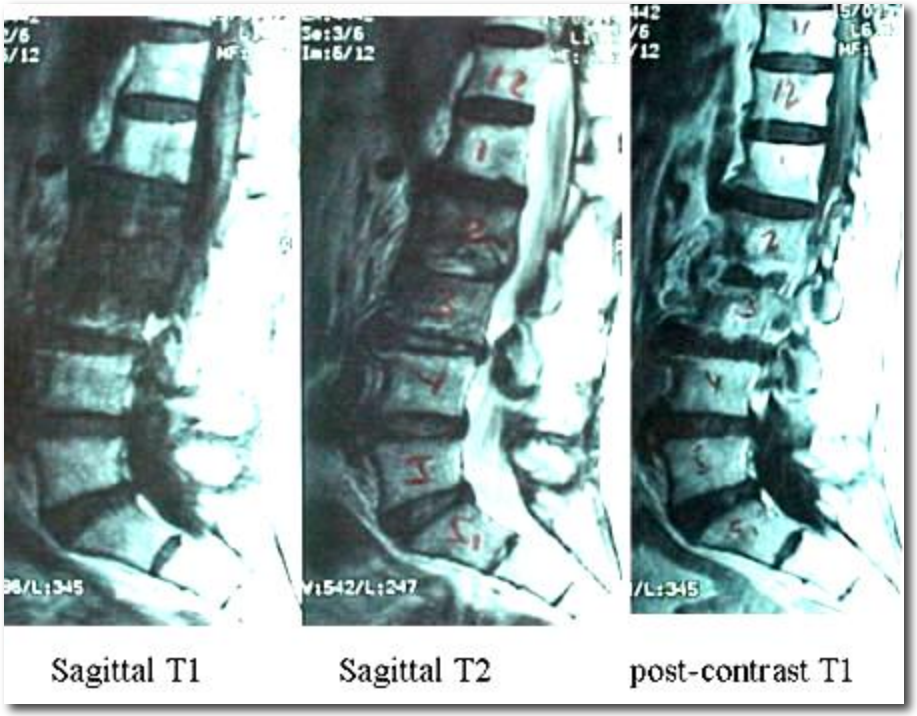
Staph. Aureus





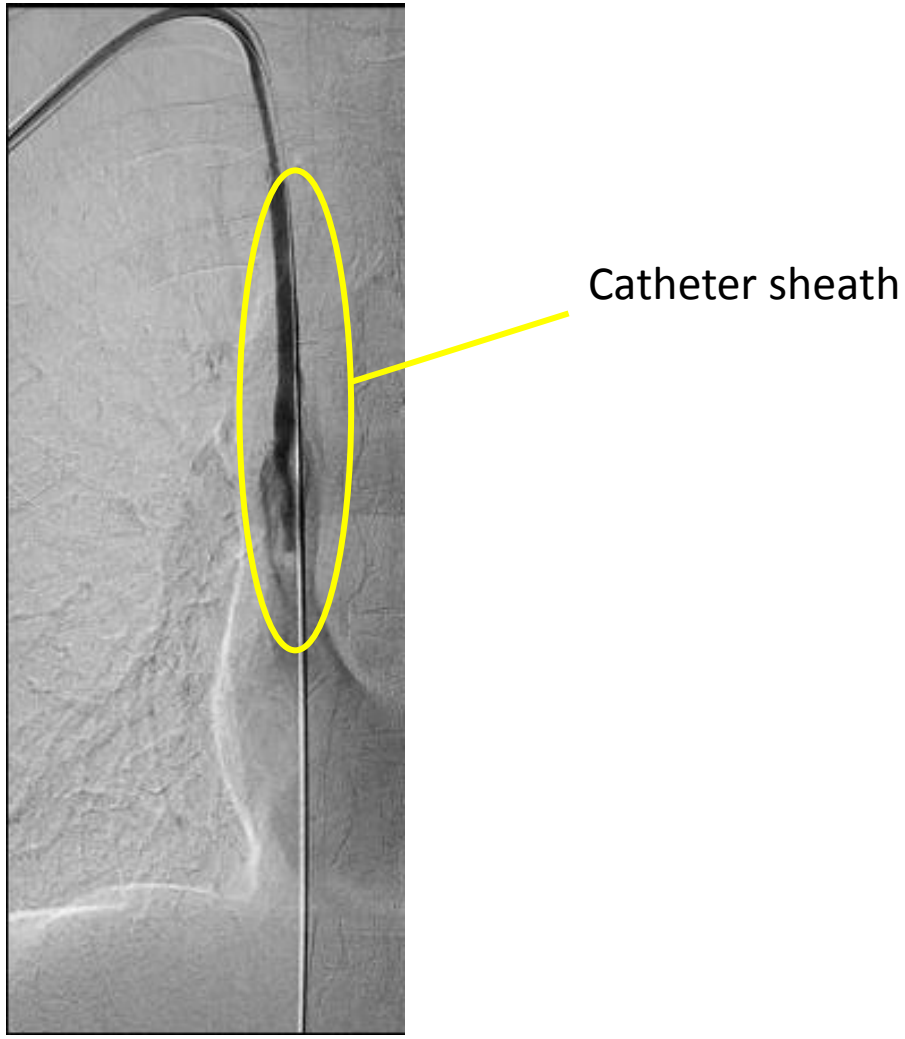
Spondylodiscitis Occurring 6 Months After CRBSI*:
Staph. Aureus



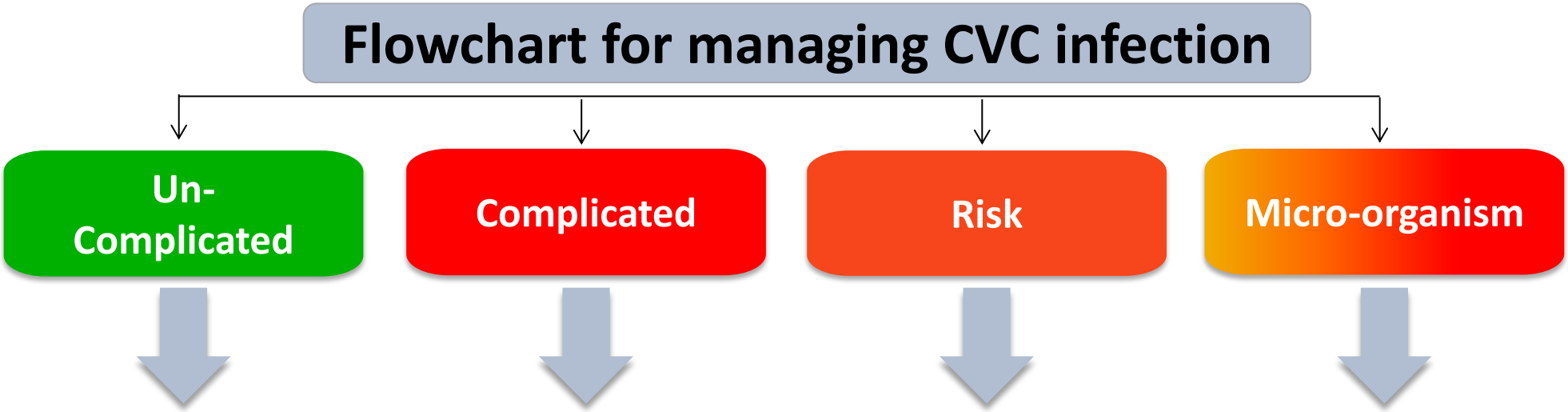


CRBSI: Catheter Related Blood Stream Infection

Catheterogram Showing CVC Sheath



Management of CVC-Related Infection



Retain CVC
+ Local skin therapy
+ CVC lock therapy
+ Systemic antibiotic
➔ *7-14 days*
Close monitoring
Reassessment
Remove CVC if not cured

Remove immediately CVC
+ Systemic antibiotic
6-8 weeks
Close & prolonged monitoring
Removable acute CVC
AVF creation/use
PD transfer

May retain CVC
+ CVC lock therapy
+ Systemic antibiotic
2-4 weeks
Close monitoring
Reassessment x3wk
And Remove CVC if deterioration, persisting or relapsing

May retain CVC
+ CVC lock therapy
+ Systemic antibiotic
2-4 weeks
Or Remove immediately CVC when complicated or Resistance or Gram Negative or Candida

Mermel LA et al. IDSA Guidelines for Intravascular Catheter-Related Infection • *CID* 2009:49:1-45

EBPG on Vascular Access

11. Management of central venous access complications

Guideline 11.1. Catheter dysfunction should be corrected by local fibrinolysis designed to restore flow patency. Repetitive catheter dysfunction requires local fibrinolysis with additional catheter imaging, microbiological assessment and systemic coagulation evaluation (Evidence level III).

Tordoir J et al, *Nephrol Dial Transplant* 2007; 22 [Suppl 2]: ii88–ii117

EBPG on Vascular Access

12. Management of the infected vascular access

Guideline 12.5. Catheter removal must be considered when catheter infection is suspected. Immediate removal should be performed in non-tunnelled catheters when infection is diagnosed (Evidence level III).

EBPG on Vascular Access

12. Management of the infected vascular access

Guideline 12.6. In tunnelled catheters with a short febrile and/or bacteraemic reaction, a delayed removal may be considered (Evidence level III). In septicaemia, immediate removal should be performed in tunnelled catheters as well.

Salvage or Not Salvage ?

Estimating Individual Risk of Retaining vs Removing an Infected Catheter

+ Benefits

- Precious catheter
- Exhausted vascular access network
- Patient characteristics: Cardiac, Oncologic, Cachectic
- Positive response to initial therapy…

Individual Patient Evaluation

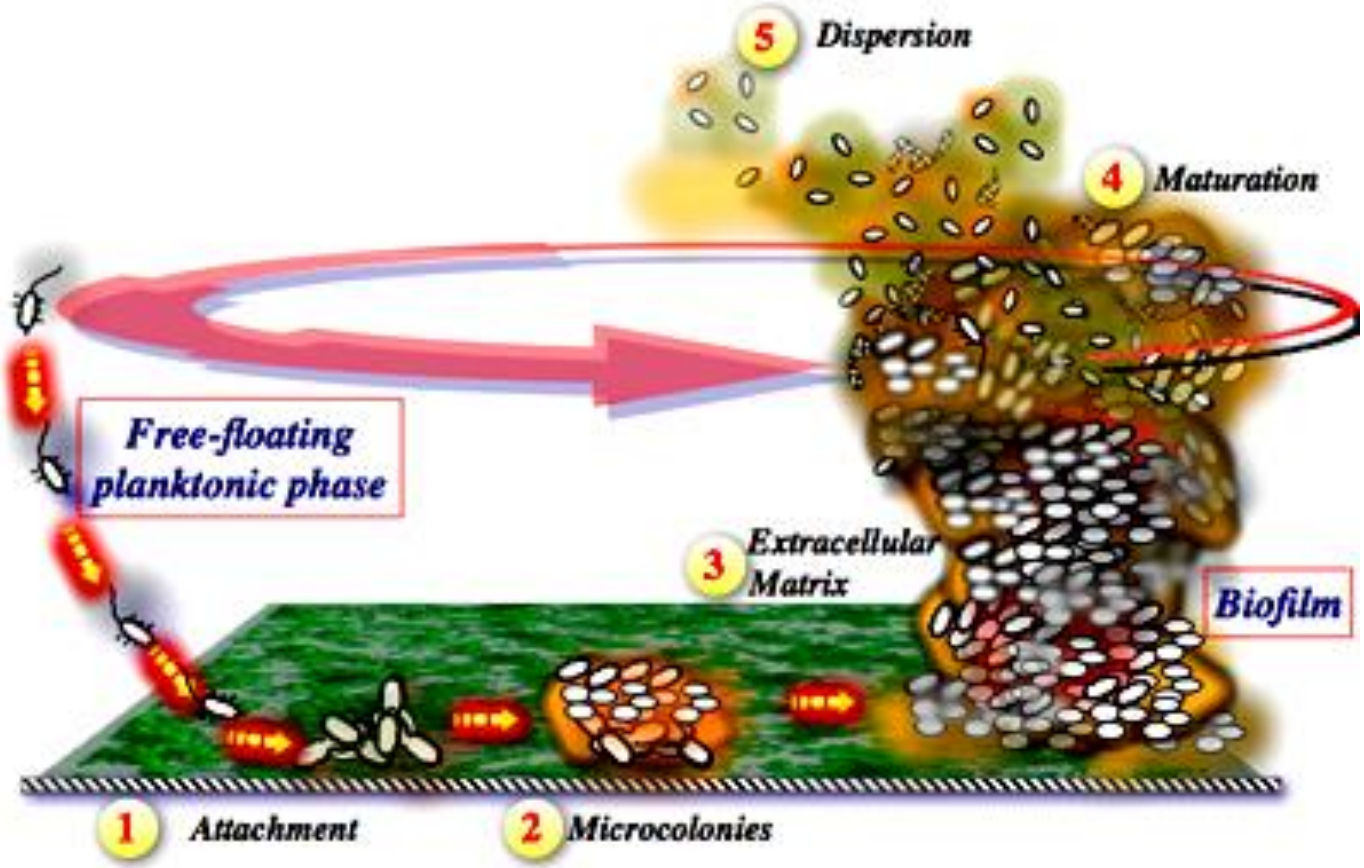
- Risks

- High risk patient
- Microorganism type
- CVC dysfunction
- Septic embolism

Bacterial Biofilm in Catheter:

A Frequent and Challenging Situation

Difficult to diagnose, High risk of bacteremia



Scanning Electron Microscopy of Bacteria Adherent to Endoluminal Catheter: Biofilm Staph. Epid. #2

Contaminated intravascular catheter
SEM x 8000

Catheter Contamination :
Diagnosing Biofilm

- **Diagnostic presumption**
  - Recurrent catheter dysfunction and/or blockage
  - Relapse or recurrent bacteremia caused by the same microorganism (*Stap. Epid or Aureus …*)
  - No visual catheter or skin abnormality
  - Subclinical inflammation or infection (CRP, Leukocytes)
- **Diagnostic certainty**
  - Positive clot (x) caused by the same microorganism
  - Positive blood cultures (x) after fibrinolysis caused by same germ
  - Positive catheter culture after CVC removal
  - Cure inflammation and/or infection

Risk Associated with Tunneled Catheter Salvage:
Prospective Observational Study

2.5 year study period (12/1/2000 – 5/31/2003)

294 Bacteremia Episodes (BE)
(22 non-TCC source excluded)

↓

272 Bacteremia episodes TCC-related

226 Patients
- 186 pts x 1BE
- 34 pts x 2BE
- 6 pts x 3BE

→ 6 lost follow-up
1 HD withdrawn
metastatic cancer

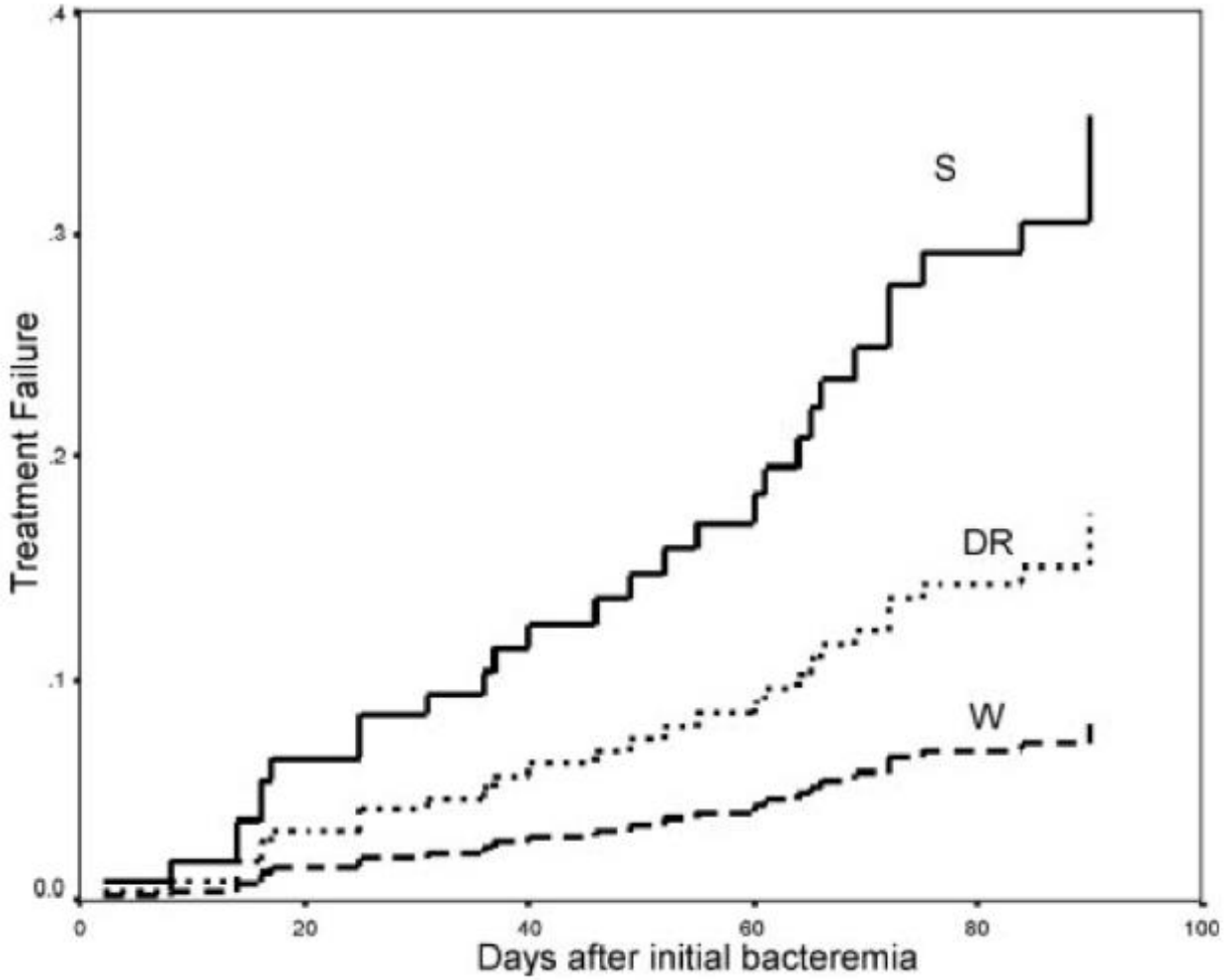
↓

219 Patients
(complete **3 months** follow-up)

Prospective observational study in USA
HD patients wit *Tunneled Cuffed Catheter (TCC)*
7 outpatient HD centers
Presenting with TCC bacteremia:
3 months follow-up and outcomes recorded

Mokrzycki MH et al. *Nephrol Dial Transplant* 2006; 21: 1024–1031

Relative Risk of Treatment Failure Following initial CVC Bacteremia According to Management



Mode of CVC management: S salvage, DR delayed reinsertion, W exchange over wire

Mokrzycki MH et al. *Nephrol Dial Transplant* 2006; 21: 1024–1031

Subset Analysis of Outcomes According to TCC Management and Microbiologic Germ

TCC management	Microbiologic isolate	Treatment failure
S	*S. aureus*	57%
	Other Gm+	17%
	Gm−	17%
W	*S. aureus*	0
	Other Gm+	12
	Gm−	0
DR	*S. aureus*	14%
	Other Gm+	8%
	Gm−	13%
O	*S. aureus*	15%
	Other Gm+	0
	Gm−	0

S, salvage; W, guidewire exchange; DR, removal with delayed reinsertion; O, removal with use of arterio-venous fistula or graft; Gm**.**, Gram-positive organism; Gm, Gram-negative organism.

Mokrzycki MH et al. *Nephrol Dial Transplant* 2006; 21: 1024–1031

Take Home Message

- Catheter-related infections and blood stream infections should be considered as serious events in hemodialysis patients
- Hemodialysis patients are fragile and high-risk patients
  - Immunocompromised, Malnourished, Comorbid
  - Exposed to repetitive invasive procedures and multiresistant bacteria
- Catheter-related infections and blood stream infections have poor outcomes
  - Treatment failure: recurrent, relapse, persistence…
  - High probability of complications: late septic metastasis
- Catheter removal or salvage is always a dilemma due to biofilm
- Management of catheter-related infection should follow strict rules of best clinical practices and close patient monitoring