Ente Ospedaliero Cantonale

# The fibroblast sleeve

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Review

JVA The Journal of Vascular Access

# The fibroblastic sleeve, the neglected complication of venous access devices: A narrative review

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**Giovanna Passaro, Mauro Pittiruti and Antonio La Greca**

| | |
|---|---|
| Fibrin sleeve | Peri-catheter thrombosis |
| Fibrin sheath | Catheter-related sheath |
| **Fibroblastic sleeve** | Catheter sleeve |

**Table 1.** Main studies on fibroblastic sleeve.

| Author | Term | Type of article | Model | Type of VAD |
|---|---|---|---|---|
| Motin et al.[1] | "Fibrin sleeve" (article in French) | Postmortem study | Human | Polyethylene catheters |
| Hoshal et al.[2] | Fibrin sleeve | Postmortem study | Human | Catheters in different materials: polyethylene, Teflon, nylon, silicon, heparin-bonded polyethylene, graphite-benzalkonium chloride-heparin-bonded polyethylene |
| Peters et al.[3] | Fibrin sheath | – | – | – |
| Borow et al.[4] | Fibrin sheath | Experimental study | Dog | Catheters in different materials: hydromer-coated polyurethane, heparin hydromer-coated polyurethane, polyvinylchloride, silicon, Teflon, polyurethane |
| Lloyd et al.[5] | Fibrinous sheath | Experimental study | Rat | Silicon catheter |
| Hombrouckx et al.[6] | Fibrin sheet | Clinical study | Human | Dialysis catheters: 12-Fr silicon and 8-Fr polyurethane |
| Raad et al.[7] | Thrombin sheath | Postmortem study | Human | Non-tunneled catheters in polyurethane or silicon. |
| Cardella et al.[8] | Fibrous sheath | Case report | Human | 3-Fr single-lumen silicon PICC |
| O'Farrell et al.[9] | Fibrin sheath | Experimental study | Rat | Silicon catheters |
| Crain et al.[10] | Fibrin sheath | Pictorial essay | Human | Double-lumen dialysis catheter; Hickman-type single-lumen catheter |
| Xiang et al.[11] | Catheter sleeve | Experimental study | Rat | Silicon catheters |
| Xiang et al.[12] | Catheter sleeve + sleeve-related thrombosis | Experimental study | Rabbit Rat | 4.2-Fr Broviac single-lumen catheters |
| Mehall et al.[13] | Fibrin sheath | Experimental protocol | Rat | 2.7-Fr silicon catheters |
| Oguzkurt et al.[14] | Peri-catheter sleeve | Prospective study | Human | 11.5-Fr polyurethane dialysis catheters |
| Keller et al.[15] | Peri-catheter sheath | Experimental study | Rat | 2.7-Fr silicon catheters |
| Forauer et al.[16] | Catheter-related (fibrin) sheath | Experimental study | Swine | 6.6-Fr single-lumen silicon catheters; 7-Fr dual-lumen silicon catheters |
| Sabbaghian et al.[17] | Catheter "cast" | Case report | Human | 9.6-Fr implantable port |
| Sinno and Alam[18] | Fibrinous sheath/ catheter related sheath/fibrin sheath | Case report | Human | Cuffed tunneled catheters; implantable ports |
| Percarpio et al.[19] | Catheter-related sheath (CRS) | Book chapter | – | – |
| Krausz et al.[20] | Fibrin sheath | Retrospective study | Human | Tunneled catheters; implantable ports; PICCs |
| Boddi et al.[21] | Fibrin sheath | Prospective study | Human | Implantable ports |
| Sylvia et al.[22] | Fibroblastic sleeve | Experimental study | Ovine | Polyurethane catheters with different coating: chlorhexidine, fluoro-oligomers, poly(2-methoxy-ethyl acrylate) |
| Tanabe et al.[23] | Catheter sleeve | Experimental study | Rabbit | Poly(2-methoxy-ethyl acrylate) catheter |
| Baciarello et al.[24] | Fibroblastic sheath | Case report | Human | 6-Fr implantable ports |
| Hill et al.[25] | Central venous access device-related sheaths | Prospective study | Human | Implantable ports |

VAD: venous access devices; PICCs: peripherally inserted central catheters.

1964

# 1971

## Fibrin Sleeve Formation on Indwelling Subclavian Central Venous Catheters

Verne L. Hoshal, Jr., MD;

Arch Surg/Vol 102, April 1971

Systematic post-mortem study

- 55 patients with subclavian CVC
- various materials
- 55 sheaths
- 2 thrombosis

Fig 1.—A 1.5-cm fibrin sleeve encompasses proximal portion of Teflon catheter indwelling only 24 hours in subclavian vein.

Fig 2.—Left clavicle is elevated exposing subclavian, internal jugular, and innominate veins. Probe is positioned in folded-up fibrin sleeve which developed around and to tip of polyethylene catheter indwelling for ten days.

# 1996

JPEN J Parenter Enteral Nutr. 1996 Mar-Apr;20(2):156-8. doi: 10.1177/0148607196020002156.

## Histologic development of the sheath that forms around long-term implanted central venous catheters

L O'Farrell [1], J W Griffith, C M Lang

Experimental study on 5 rats

- Cannulated veins with silicone catheter
- 3, 7, and 60 days post-implantation

*«The coating that developed around the external portion of the catheter started […] containing fibrin and progressed into vascularized, fibrous connective tissue»*

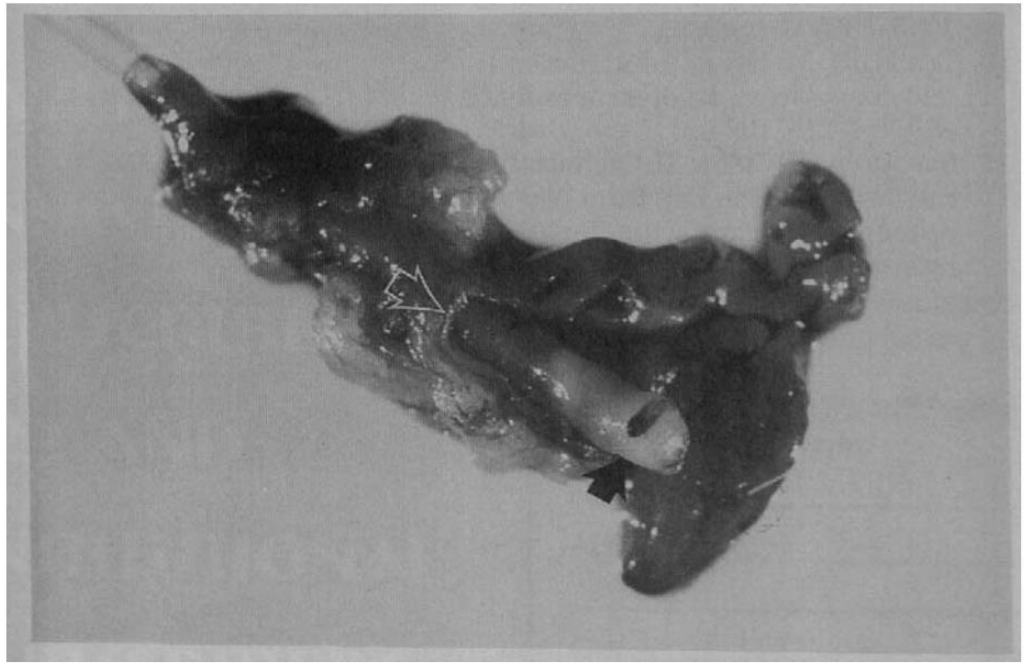


FIG. 2. A white sheath surrounds the catheter (solid arrow) and blocks the tip 8 weeks after implantation. The open arrow indicates the vein wall.

# 1998

## Composition and formation of the sleeve enveloping a central venous catheter

D.Z. Xiang, MD, E.K. Verbeken, MD, PhD, A.T.L. Van Lommel, PhD, M. Stas, MD, and I. De Wever, MD, PhD, *Leuven, Belgium*

*Università Cattolica di Leuven (Belgio)*

*Conclusion:* The sleeve around a central venous catheter is not a fibrin sleeve, but a stable cellular-collagen tissue covered by endothelium. It is mainly formed by smooth muscle cells migrating from the injured vein wall into the early pericatheter thrombus. (J Vasc Surg 1998;28:260-271.)

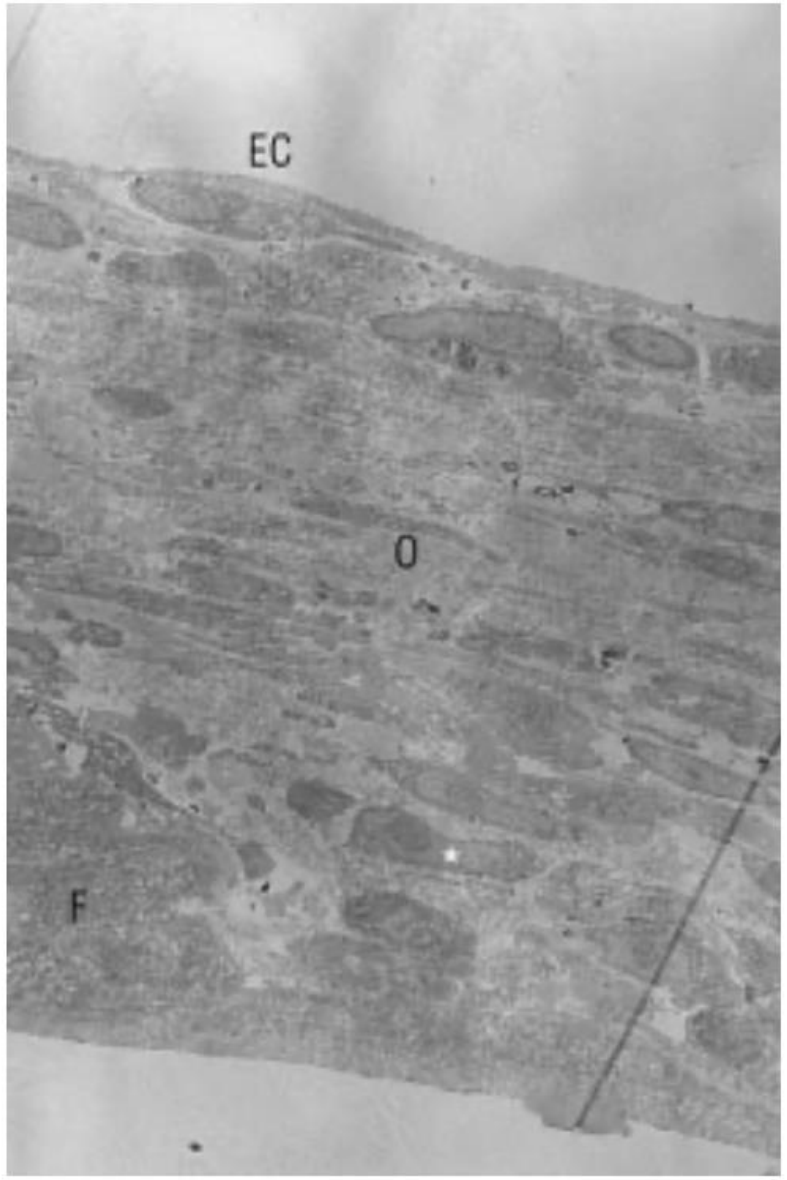



Fig. 6. Day 7: This overview picture of the sleeve shows a layer of endothelial cells (*EC*) at the luminal side, several layers of smooth muscle cells of the synthetic phenotype (*star*) with collagen (*0*) in between, and still some fibrin (*F*) at the catheter side(TEM, 1440×).

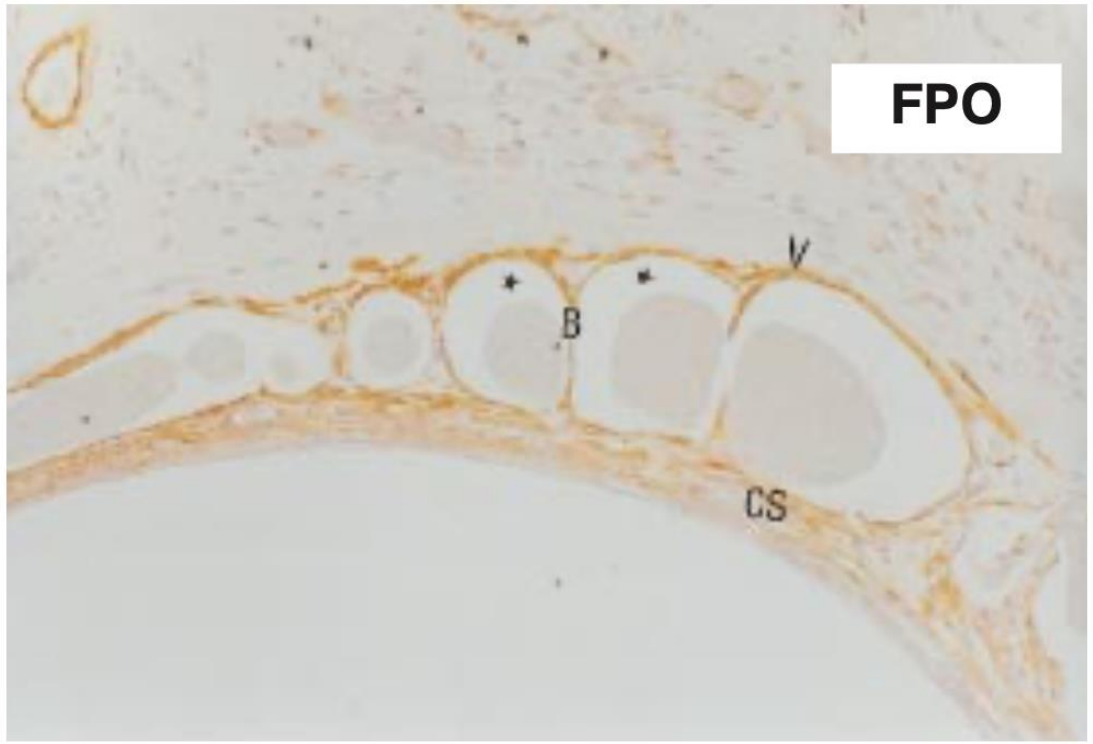
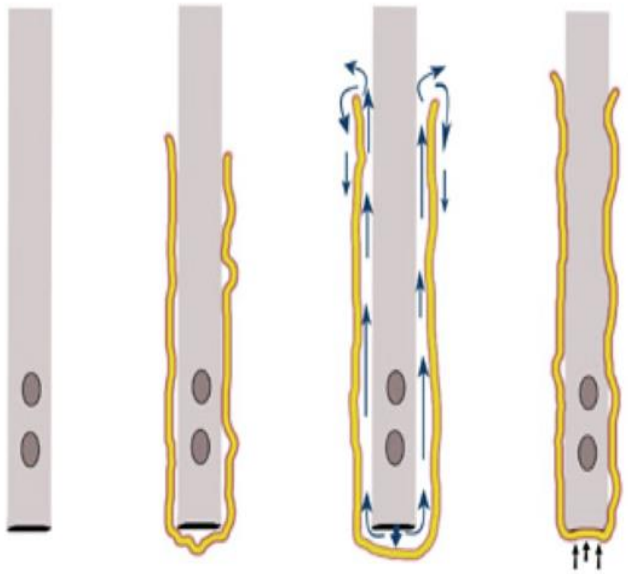
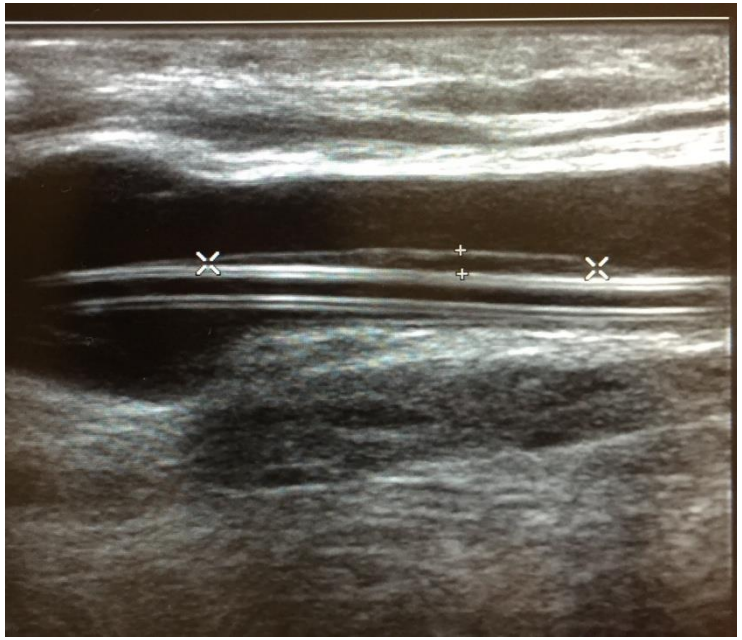


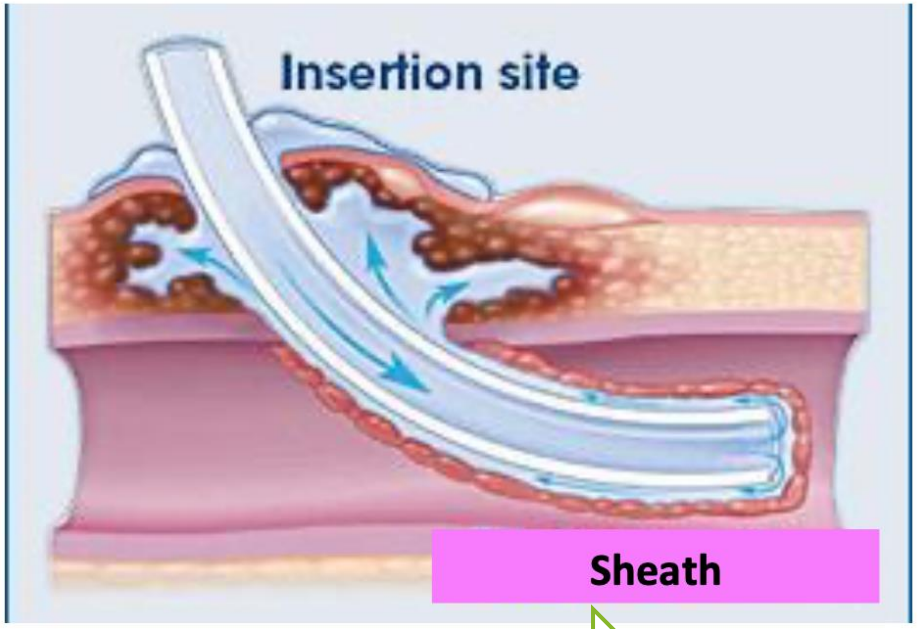

Fig. 5. Day 7: Several connecting bridges (*B*) divide the barium-filled space (*star*) between the vein wall (*V*) and the catheter sleeve (*CS*). These tiny bridges, filled with α-actin positive cells, indicate the migratory pathway of the smooth muscle cells (original magnification, 200×; α-actin stain).

*Xiang et al / JVS 1998*

# The fibro-blastic sleeve today



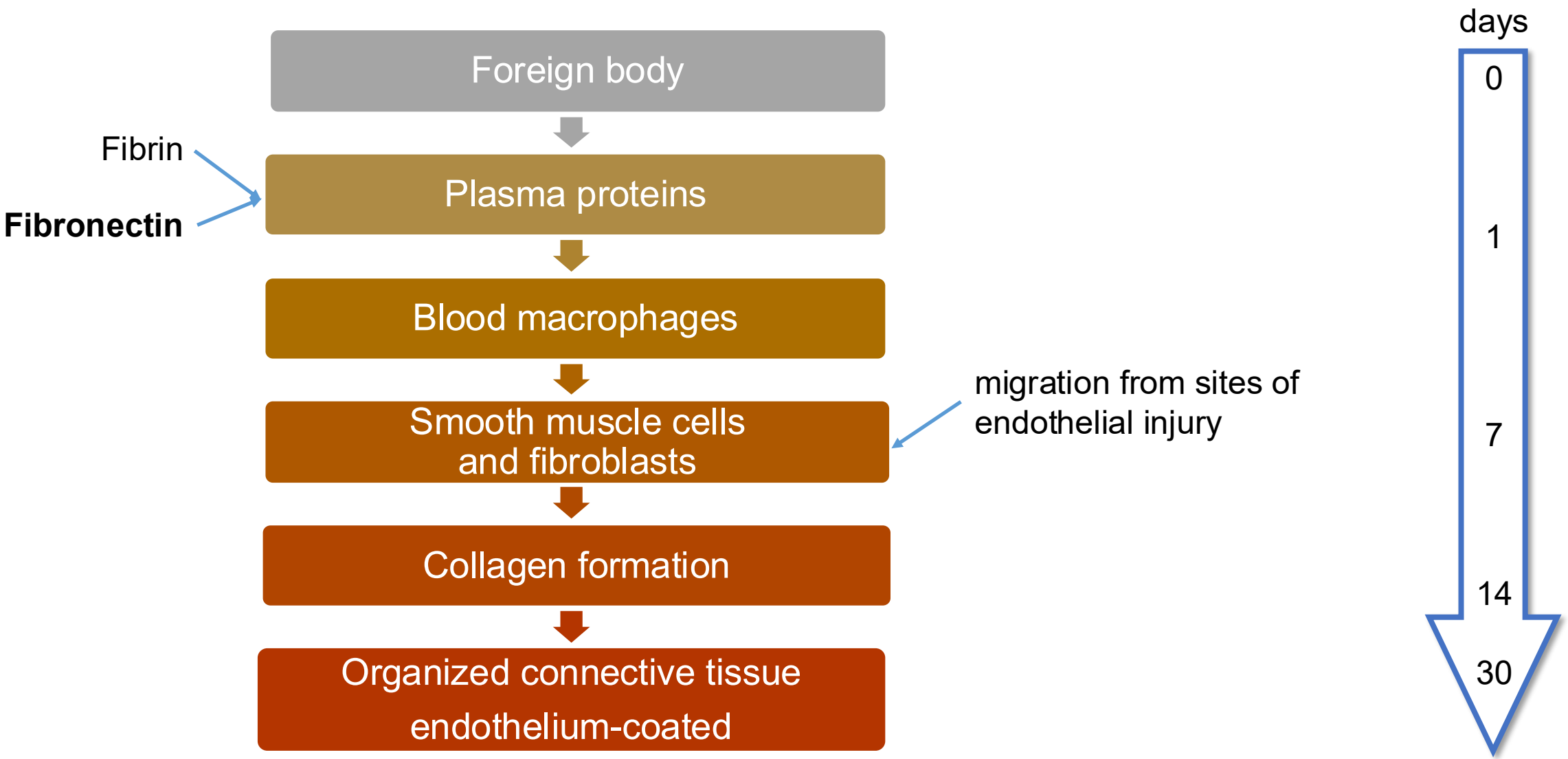





**EARLY EVENT**

**LATE CLINICAL MANIFESTATION**

# Pathogenesis



# Risk factors

**Well-established**

- Short catheters (rapidly covered within days)
- Primary malposition (not at the cavo-atrial junction)
- Long catheter dwell time

**Uncertain**

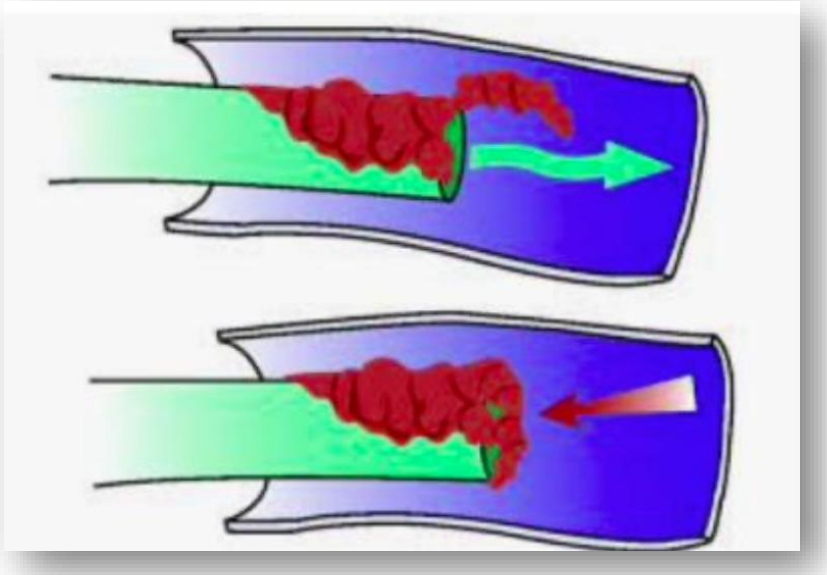
- Diabetes?
- Rigid catheters?
- Non–chlorhexidine-coated catheters?

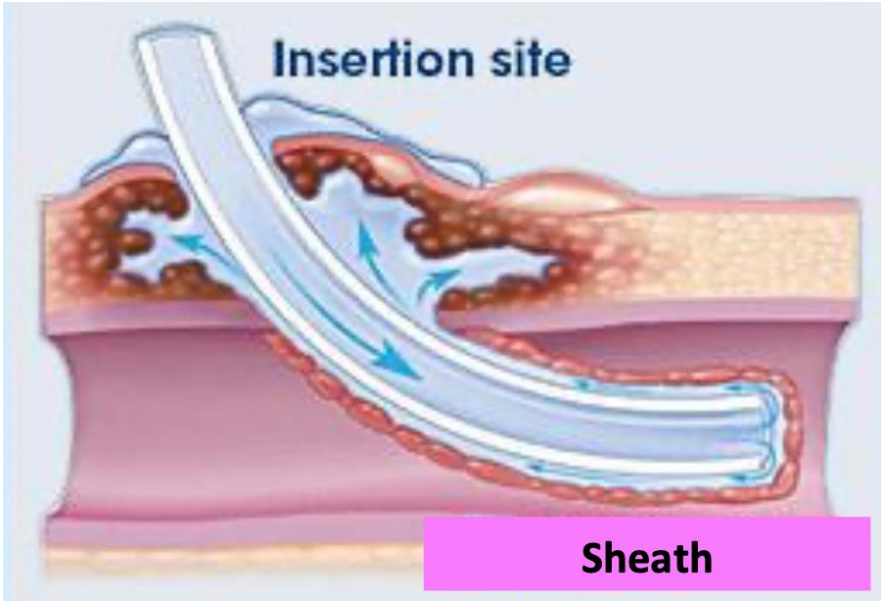
# Clinical features

**Incidence**

- 10–56% in clinical reports
- ≈100% in experimental studies

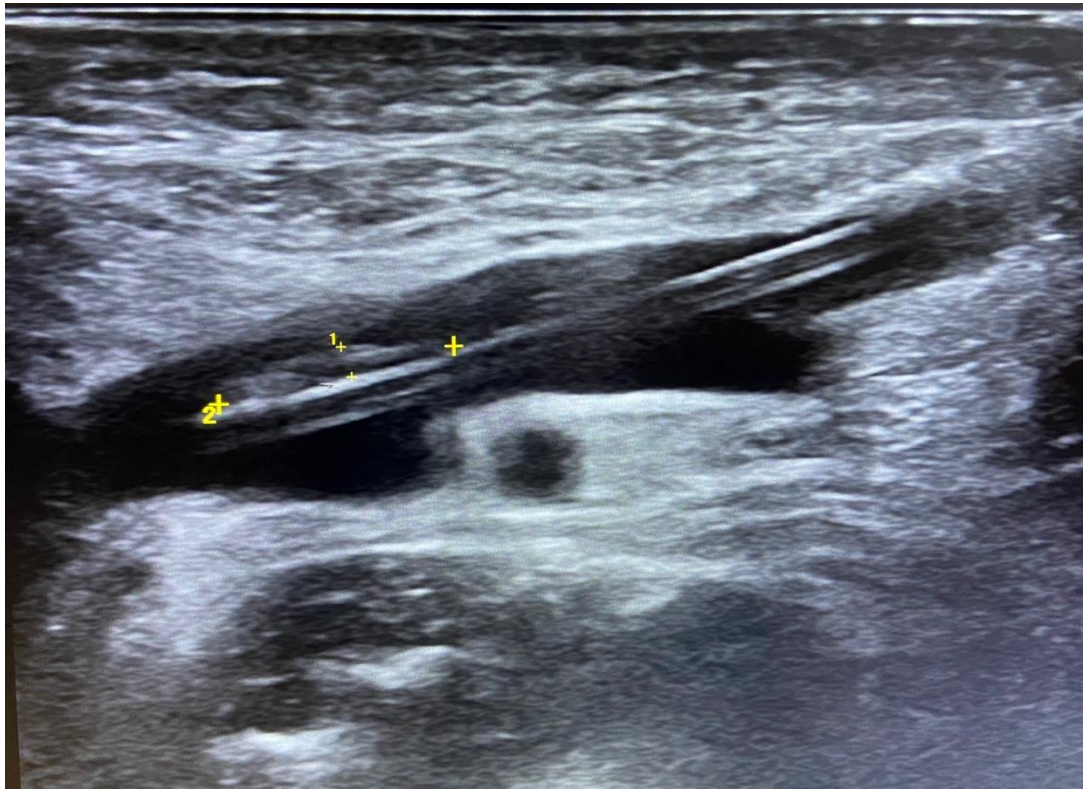
- **Often asymptomatic**
- Infusion difficulties
- **Persistent withdrawal occlusion (PWO)**
  - Unidirectional valve effect
  - (more frequent with valved-tip catheters)
- Extravasation at:
  - Exit site
  - Tunnel
  - Reservoir pocket



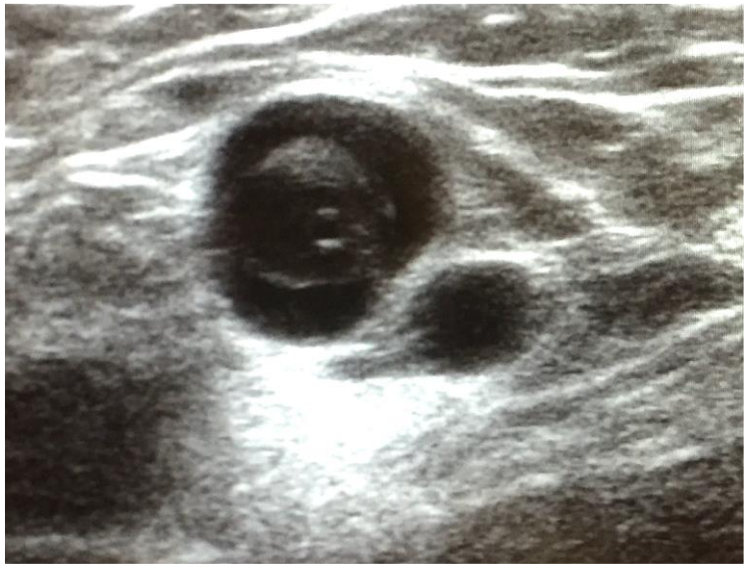


# Ultrasound Diagnosis

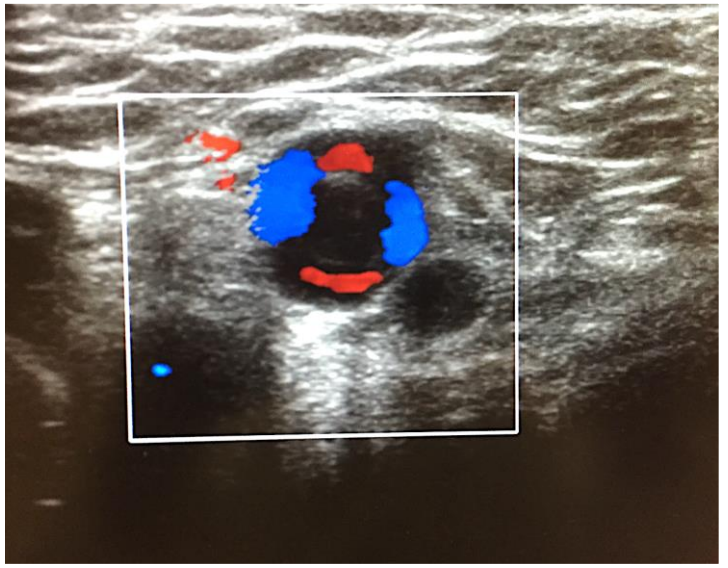
- Homogeneous echogenic material
- Thickness 1–2 mm
- Smooth surface
- No extensive adherence to the venous wall (only “bridges”)
- Preserved pericatheter flow
- Target image (“circle sign” / “ring sign”)

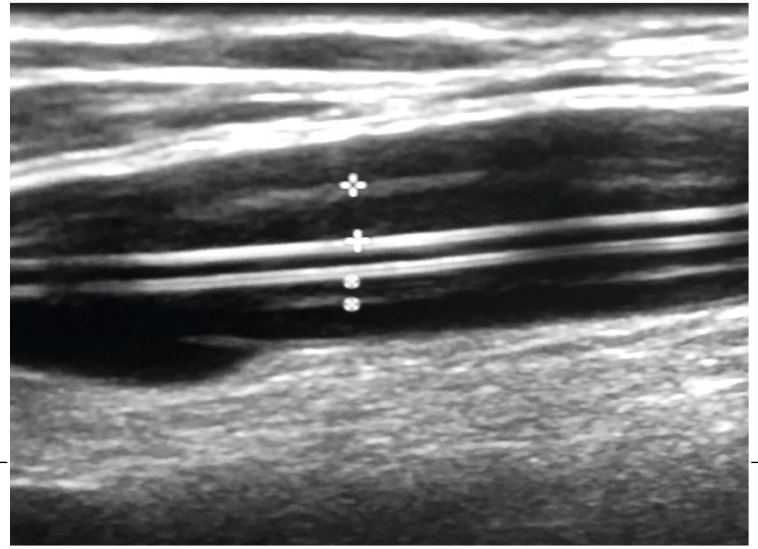


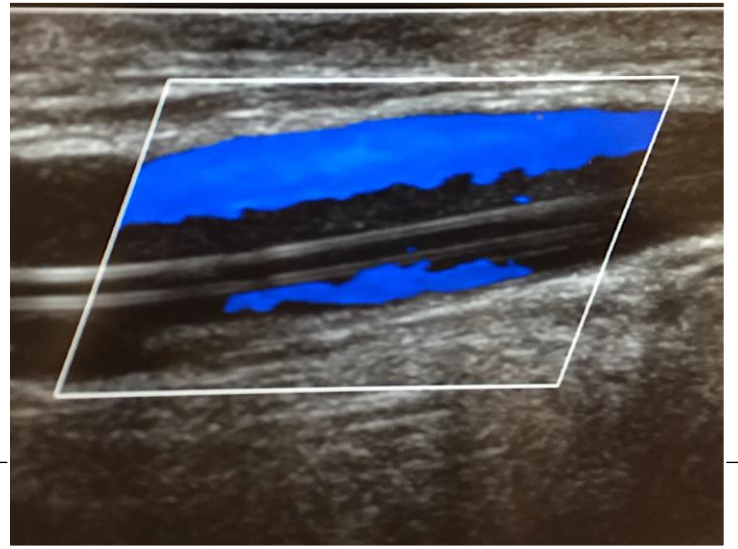
# Ultrasound Findings



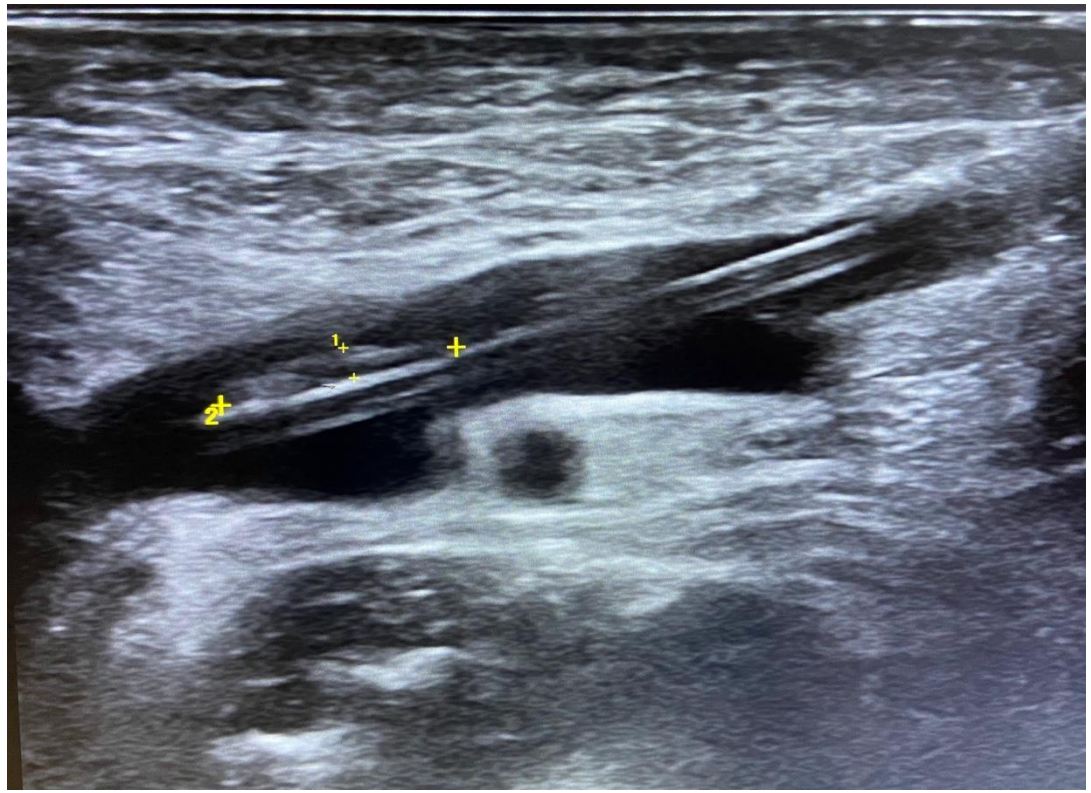
Circle sign / Ring sign

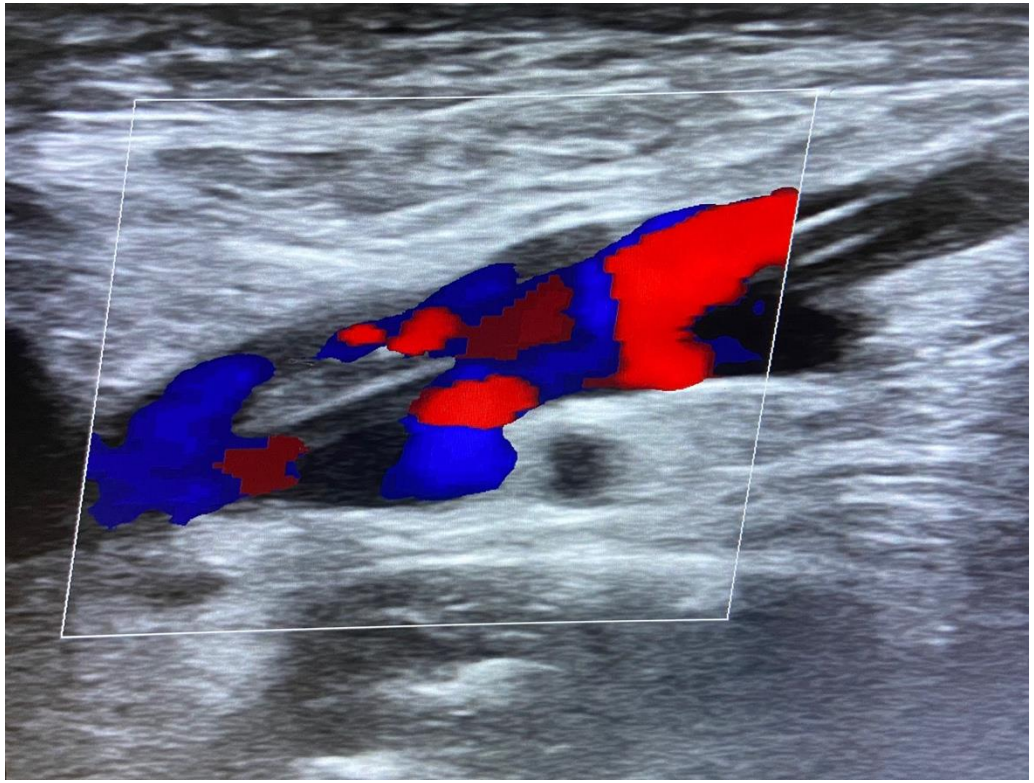




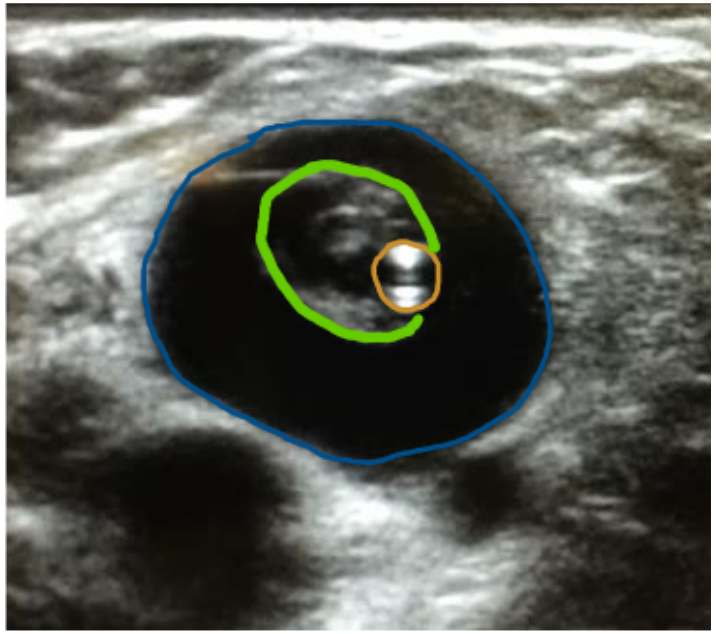


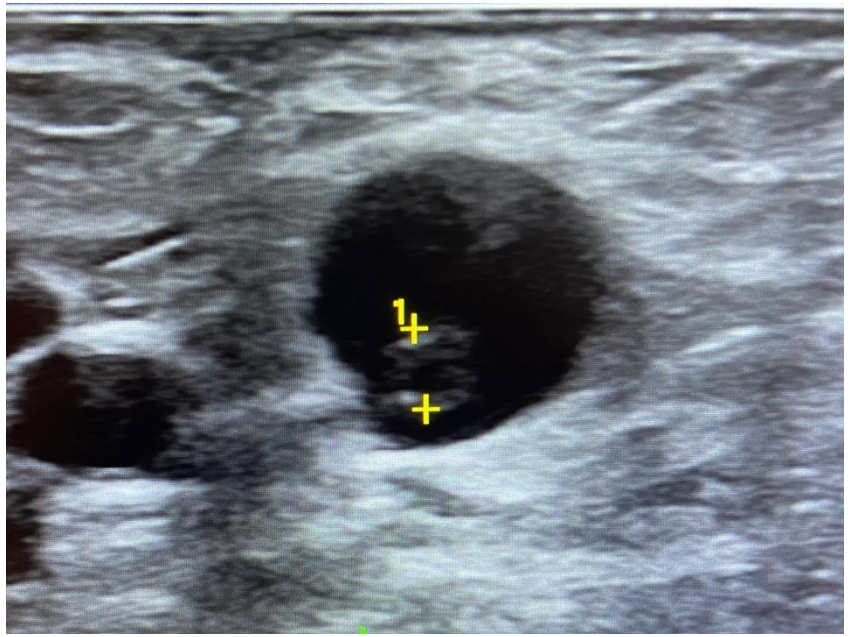
# Ultrasound Findings

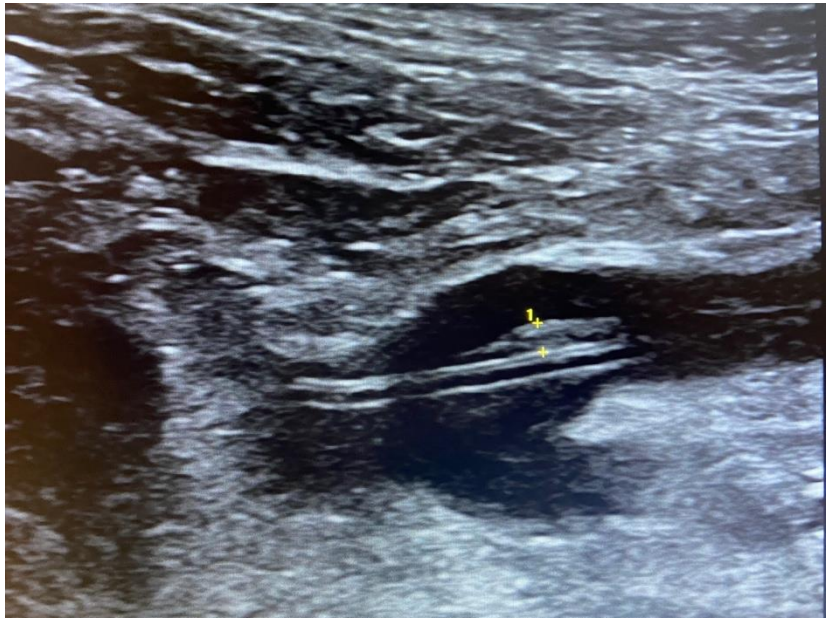




# Ultrasound Findings







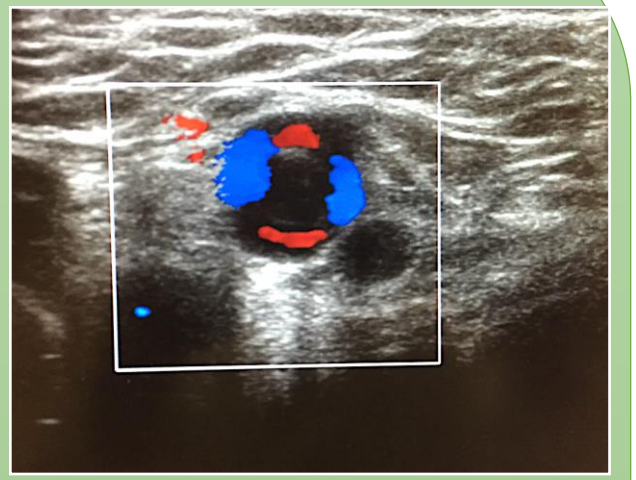
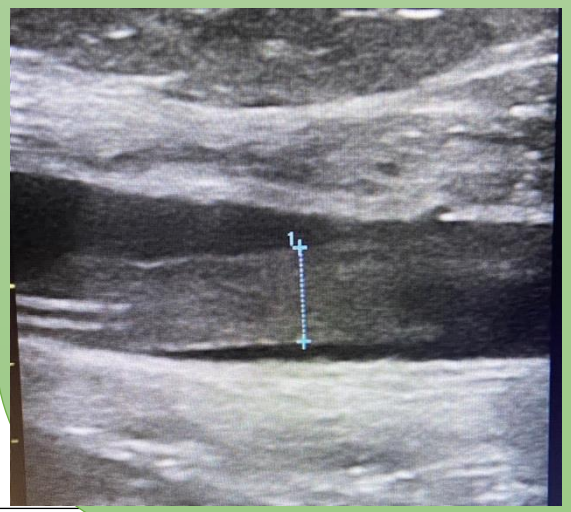
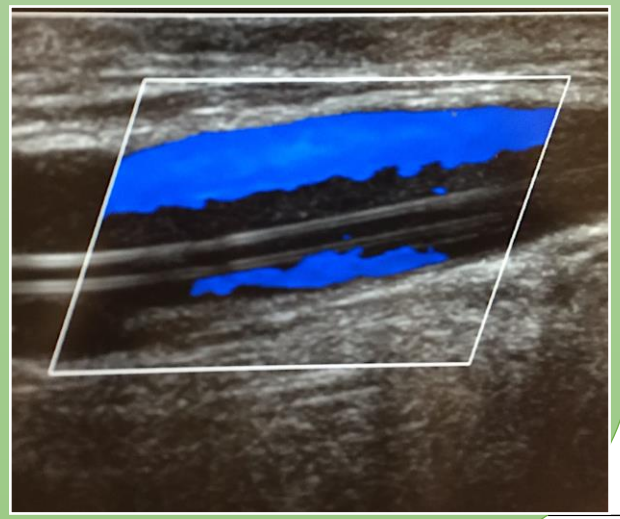
# Is this a positive CUS?

# «Ghost» catheter

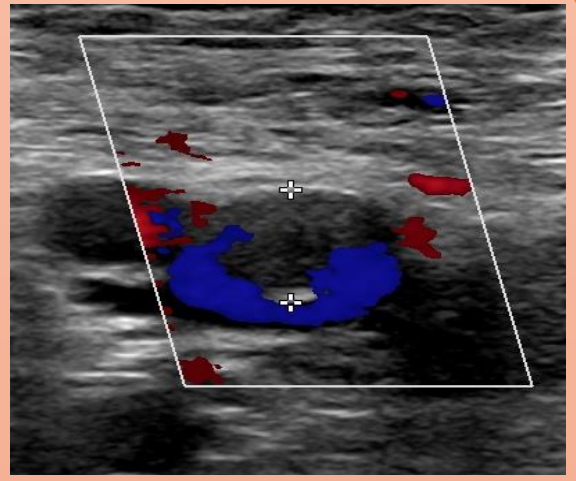
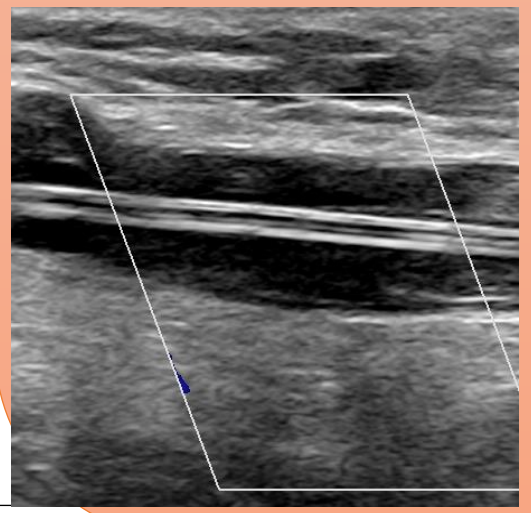
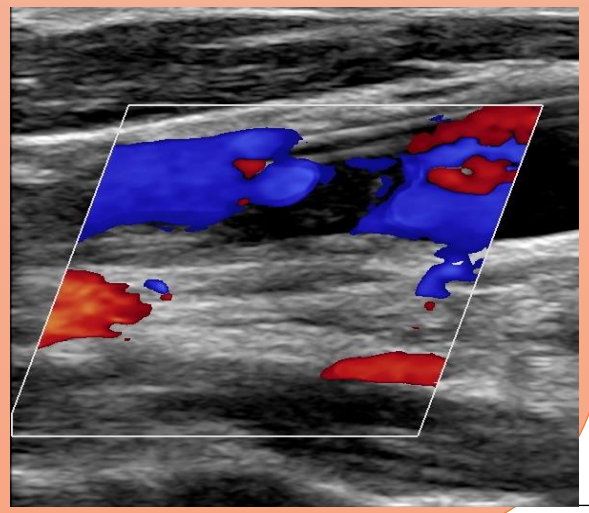

Rare case-reports of benign embolism: Fabiani A et all, J Vasc Access (2025)

# Differential Diagnosis

## Fibroblast sleeve

## Catheter-related thrombosis

# Summary of differences

**Table 3.** Main differences between catheter-related thrombosis (CRT) and fibroblastic sleeve (FS).

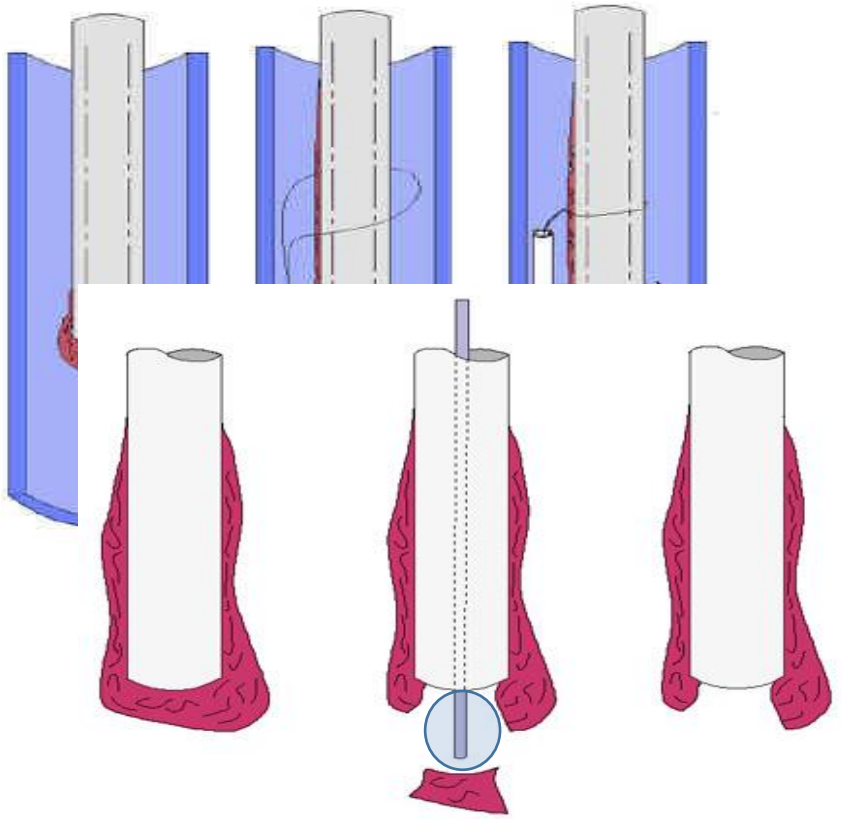
| | CRT | FS |
|---|---|---|
| Etiopathogenesis | Endothelial damage | Foreign body reaction |
| Molecular trigger | Tissue thromboplastin | Fibronectin |
| Type of tissue | Thrombus | Connective tissue |
| Location | At the site of vein wall damage | Around the catheter |
| Evolution | Fibrosis/reabsorption | Reabsorption (?) |
| US imaging | Mass obstructing the vein | Sleeve all around the catheter |
| | Anechoic, and then hypo-echoic | Hypo- or hyper-echoic |
| | Mainly attached to the vein wall | Mainly attached to the catheter |
| Clinical manifestation | Signs and symptoms of venous obstruction + risk of catheter malfunction | Catheter malfunction |
| Risk of pulmonary embolism | Yes | No |
| Need for VAD removal | Rare (not responsive to therapy) | Rare (irreversible catheter malfunction) |
| Preventable with anticoagulants | Yes (not consistently) | No |
| Sensitive to thrombolysis | Yes (in the initial phase) | No |
| Pharmacological management | LMW heparin | None |

VAD: venous access devices; US: ultrasound; LMW: low-molecular-weight.

***Passaro et al. / JVA 2021***

# Treatment (only if symptomatic!)

**NO TROMBOSIS -> NO ANTICOAGULANTS**



- Mechanical unclogging (5 ml syringe)
- Removal and re-insertion
- Angiographic "peeling" or "stripping»
- Balloon expansion
- Fibrinolytic agents → was really a FBS??
- Over-wire replacement (preserve the reservoir for ports) → small literature

# Prevenzione

| Cat.related thrombosis | FBS |
| --- | --- |
| Catether/vein ratio 1/3 | |
| Minimizing venous punctures/trauma | |
| Well-positioned tip | |
| Stabilized catheter | |
| Anticoagulants profilaxis in subjects at risk | |

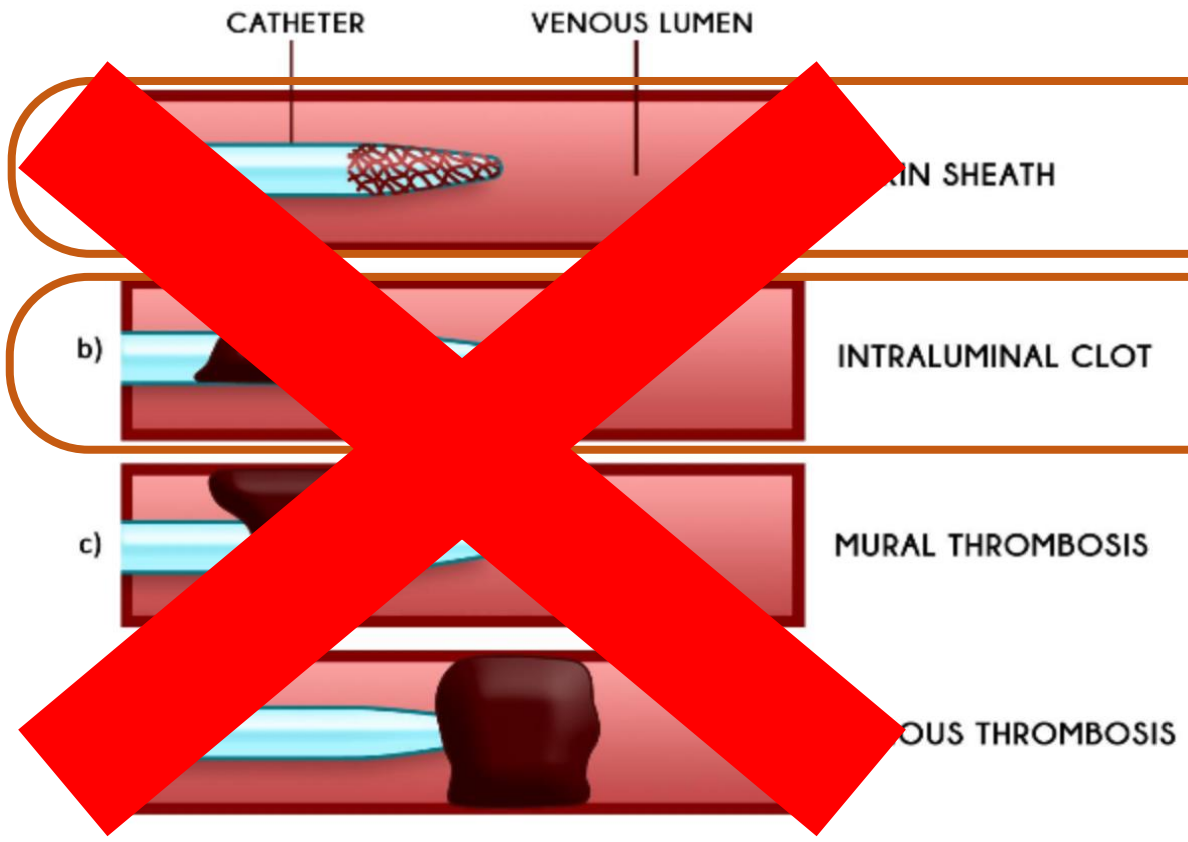
# Re-reading the literature

Thrombosis Research 187 (2020) 103–112

Contents lists available at ScienceDirect

Thrombosis Research

journal homepage: www.elsevier.com/locate/thromres




**NOT THROMBOSIS but:**

- Fibroblast sleeve
- clot (blood reflux)
- lipid aggregates (NPTs)
- drug precipitates (incompatibility)

**Figure 1 - Different kinds of thrombosis related to catheter use**

*Citla Sridhar D, Abou-Ismail MY, Ahuja SP. Central venous catheter-related thrombosis in children and adults. Thromb Res.* ***2020***

# TAKE HOME MESSAGE

- Prendete atto della esistenza della guaina fibroblastica!
  - Ditelo ai Vostri colleghi
  - Ditelo ai Vostri radiologi
  - Ditelo ai Vostri ecografisti
  - Ditelo ai Vostri angiologi
  - Ditelo a tutti coloro che gestiscono pazienti con PICC

RICORDARE:

**- La maggior parte delle 'trombosi asintomatiche' sono in realtà guaine fibroblastiche: è necessario imparare a distinguere tra trombosi e guaina, per il bene del paziente!**

# Thanks