



Dr. Ajit Yadav

**Consultant, Interventional Radiology
Sir Ganga Ram Hospital, Delhi, India.**



Embolization

Adjunctive goal

- Preoperative
- Adjunct to chemotherapy or radiation therapy

Curative goal

- Aneurysms
- Arteriovenous fistulae [AVFs]
- Arteriovenous malformations [AVMs]
- Traumatic bleeding

Palliative goal

Relieving symptoms, such as those of a large AVM, which cannot be cured by using embolization alone

Medical conditions treated by using embolization are as follows

- Vascular anomalies (AVM, AVF, venous malformation, and hemangioma)
- Haemorrhage (pseudoaneurysms and GI tract, pelvic, posttraumatic, epistaxis, and haemoptysis bleeding)
- Other conditions (tumors, varicoceles, and organ ablation)

Embolizing Agents

Temporary

Gelfoam

Permanent

Nonabsorbable microparticles

- PVA
- Microspheres (Embolospheres)

Mechanical agents

- Coils
 - Pushable
 - Injectable
 - Detachable
- Vascular Plugs

Liquid agents

Sclerosants

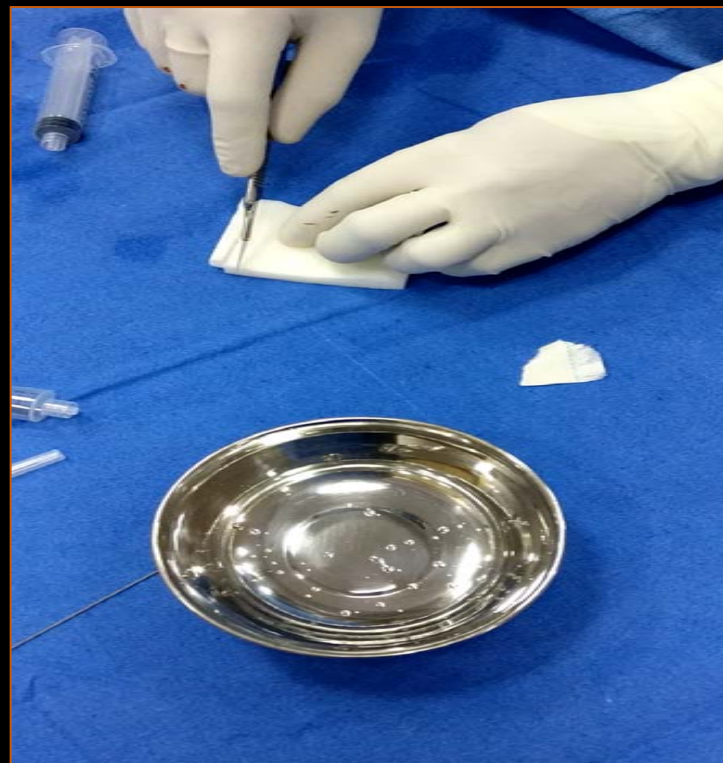
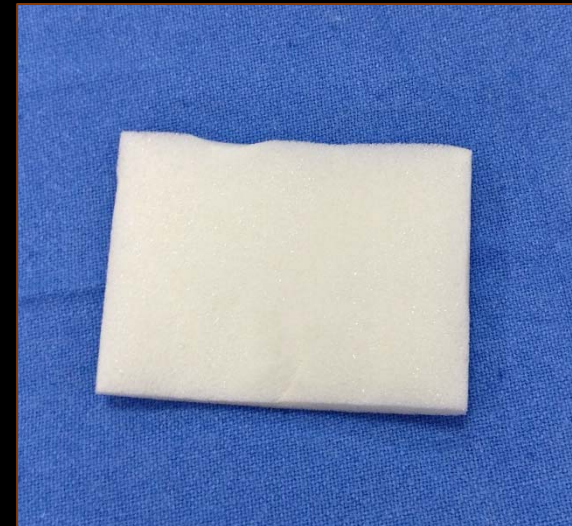
- Ethanol
- Sodium tetradecyl sulfate

Polymers

- NBCA glue,
- Ethylene vinyl alcohol (Onyx)

Gelfoam

- Water-insoluble hemostatic material
- Prepared from purified skin gelatin (a non-antigenic carbohydrate)
- Biodegradable, absorbable embolic agent
- Within days after Gelfoam administration, acute inflammatory and foreign body, giant cell reactions observed.
- Cellular reaction initiated by Gelfoam abated by day 30 and no Gelfoam or thrombus was seen at day 45.



Gelfoam

Advantage

1. The temporary nature of gelatin foam occlusion used in Trauma
2. Low cost
3. Versatility of use
4. Extensive clinical experience

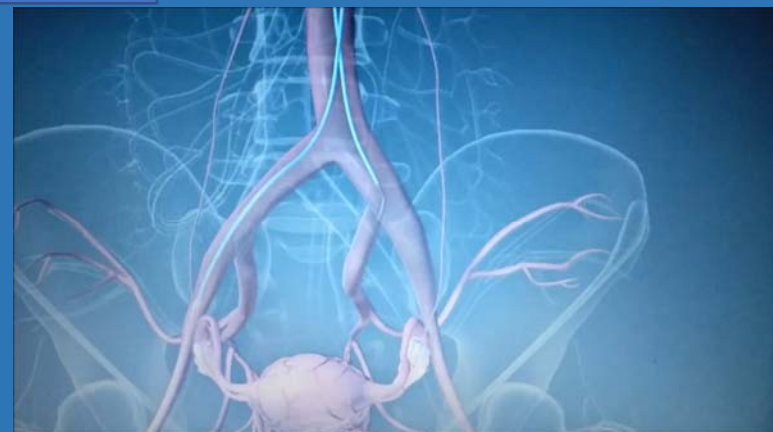
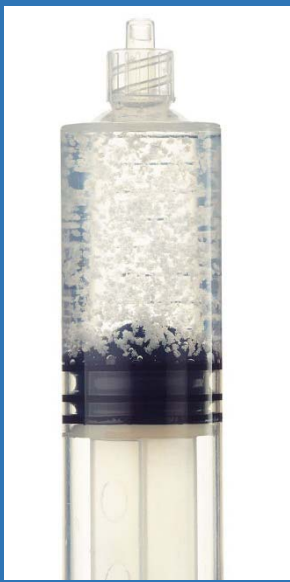
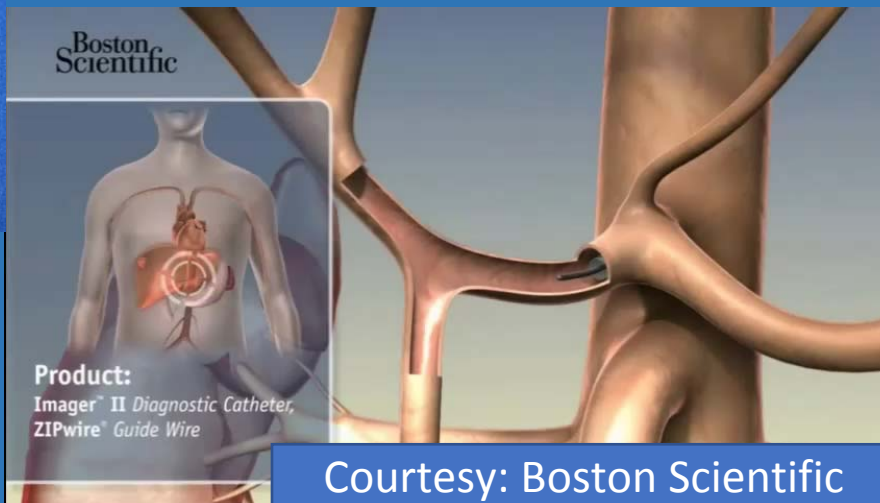
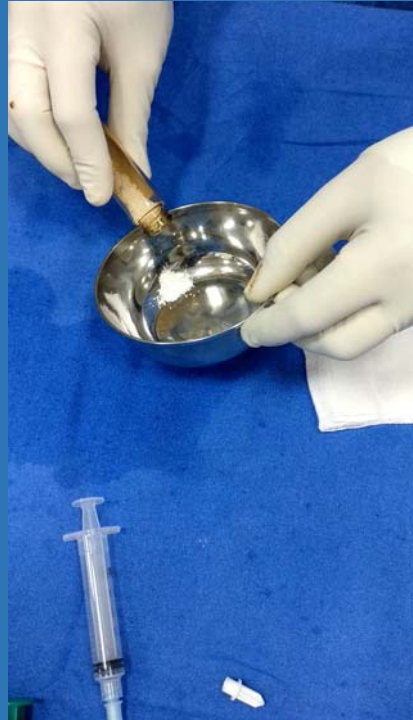
Disadvantage

1. Gelatin foam powder can potentially cause ischemia due to the small size
2. Not useful for aneurysm embolization
3. Gelfoam can be associated with infection due to trapped air bubbles

Polyvinyl Alcohol Particles (PVA)

- The particles are made from a PVA foam sheet that is vacuum dried and cut into particles.
- Biocompatible.
- The particles are filtered with sieves and are available in sizes ranging from 100 μ m to 1100 μ m
- PVA particle causes inflammatory reaction and focal angioneclerosis, with vessel fibrosis developing over time.





Polyvinyl Alcohol Particles (PVA)

Advantage

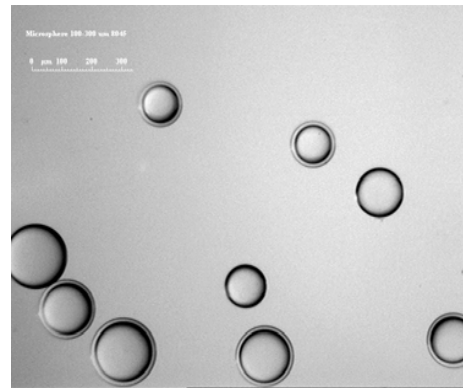
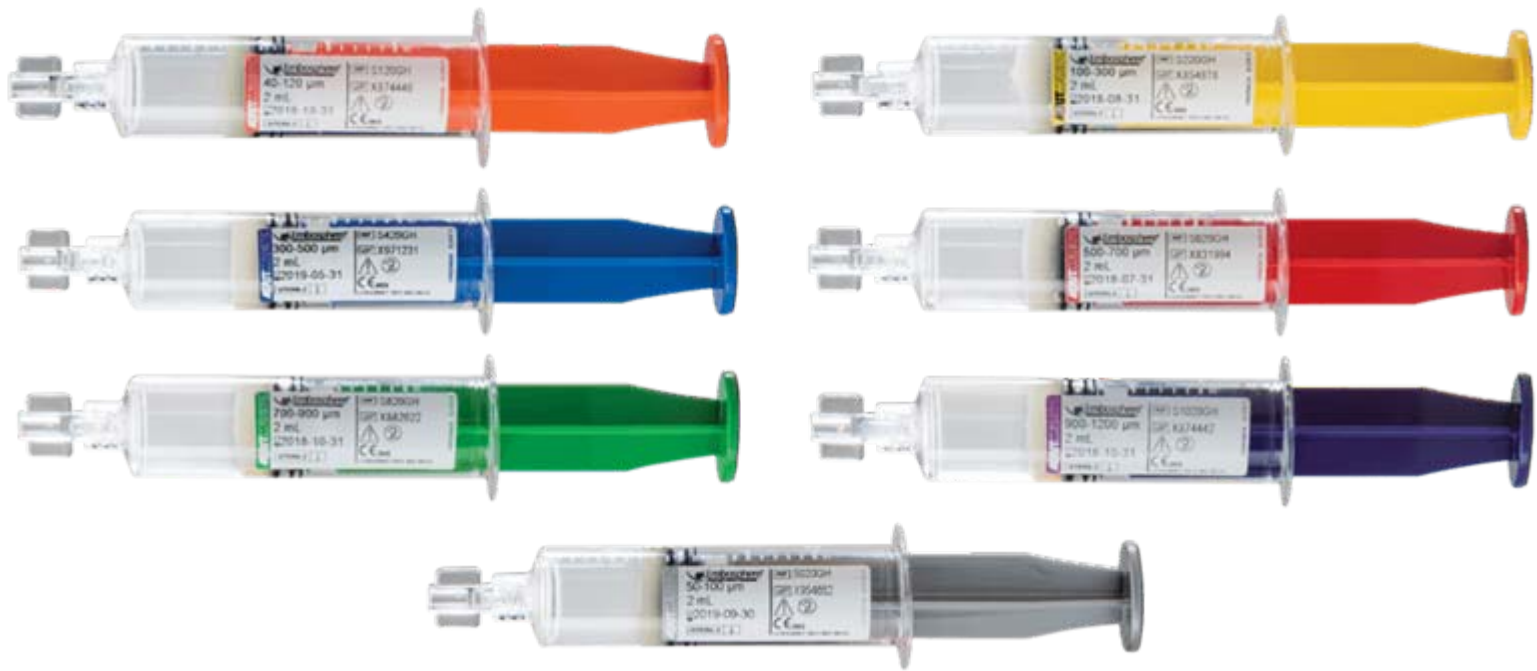
1. Non-absorbable or permanent embolic agent
2. Potential to occlude target vessel at desired point along the course of that vessel
3. Easy Availability
4. Extensive clinical experience

Disadvantage

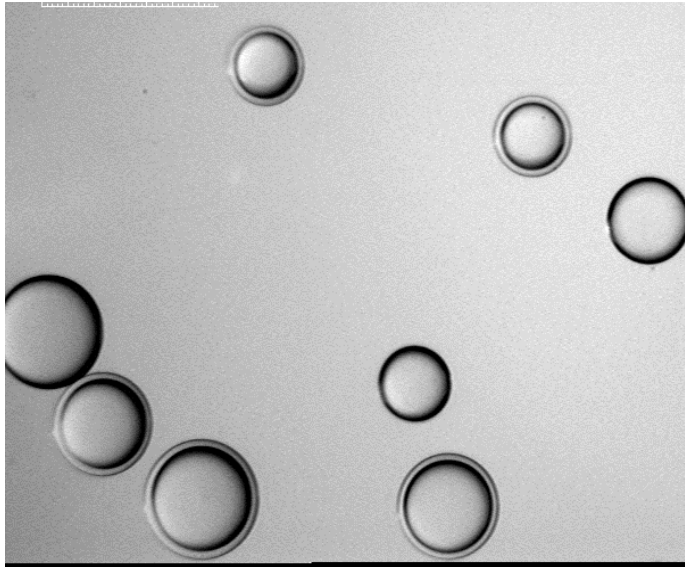
1. Tendency to aggregate, occluding vessels more proximally
2. Particle clumping can also cause catheter occlusion.
3. Inclusion of small particles in early preparations of PVA increased the risk for inadvertent end-organ injury

Spherical Embolic Agents (Embosphere)

- Made from an acrylic polymer matrix impregnated and embedded with porcine gelatin.
- Nonresorbable hydrophilic particles that are precisely calibrated by size.
- Can be temporarily compressed by 20 to 30% of their initial diameter.
- Embospheres can be identifiable for years intra- and extravascularly, and degeneration of the spheres has not been observed.

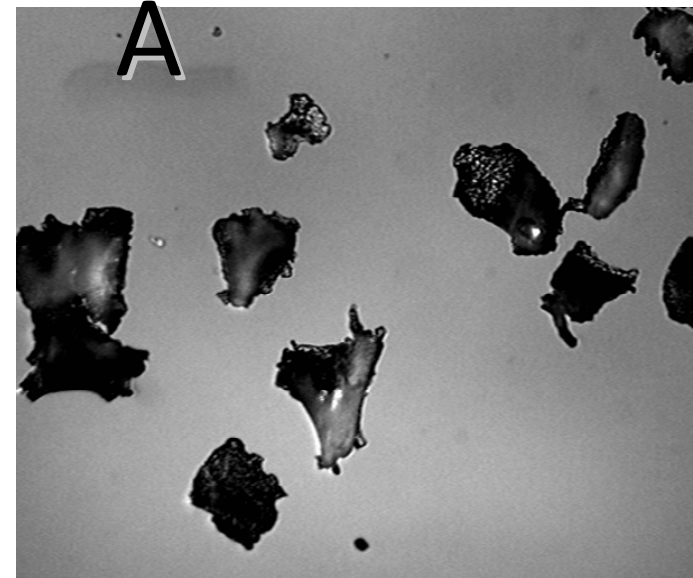


Embosphere

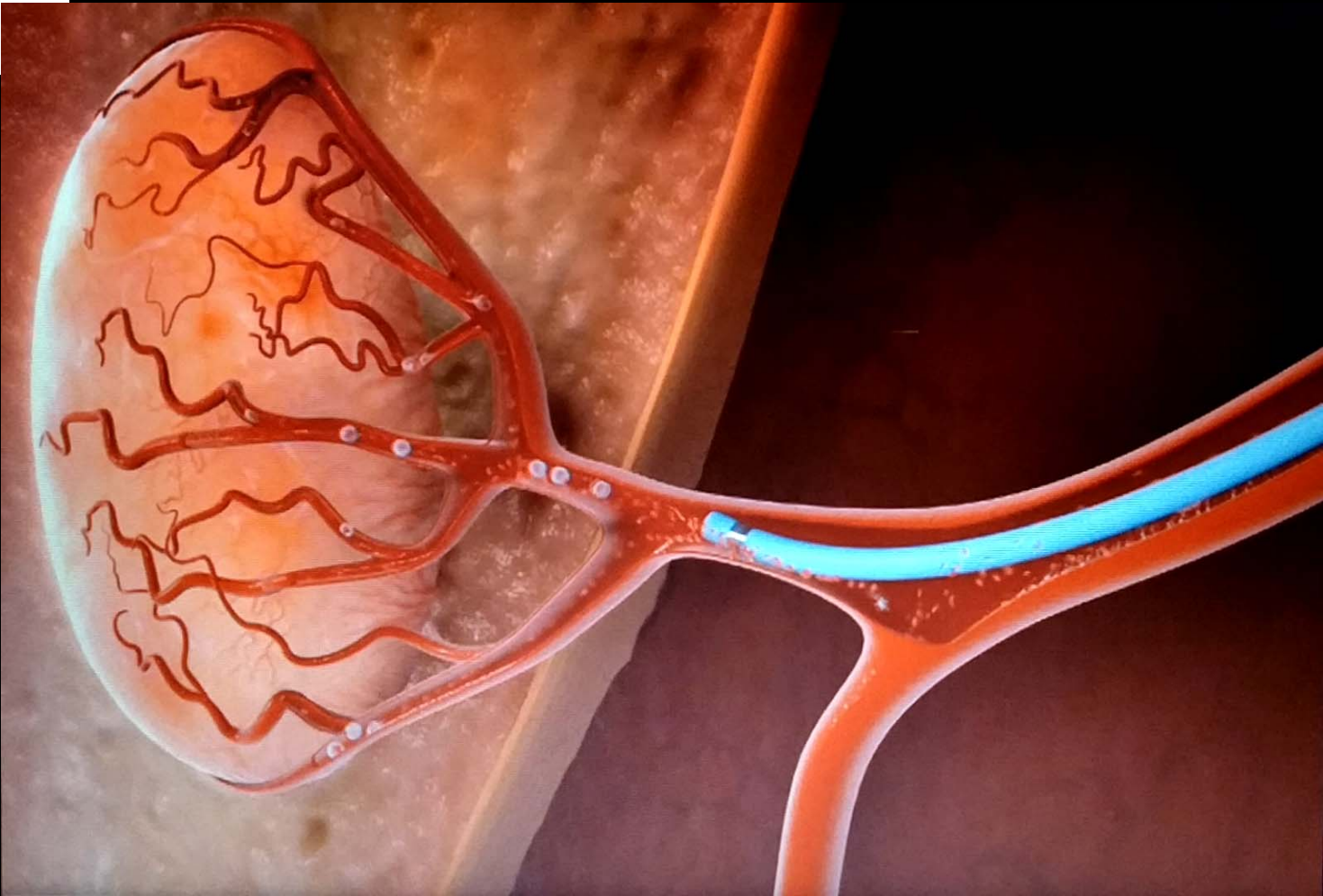
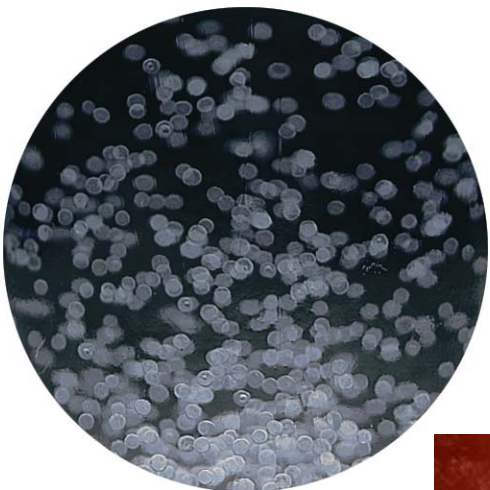


- Spherical
- Non Aggregating
- Uniform occlusion
- Predictable penetration

PV



- Irregular shape
- Clumping
- Non-uniform occlusion
- More proximal occlusion



Spherical Embolic Agents (Embosphere)

Advantage

1. Non-absorbable or permanent embolic agent
2. Potential to occlude target vessel
3. No tendency to form aggregates
4. Controlled arterial occlusion

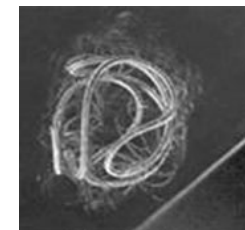
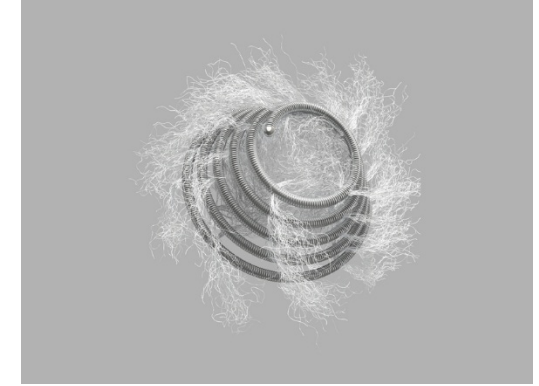
Disadvantage

1. Need for intermittent agitation to prevent sedimentation and maintain suspension
2. Porcine gelatin-can be allergic

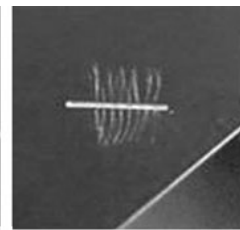
Coils

- Gianturco et al designed and described the use of coils for embolotherapy in 1975
- Intimal injury
- Promotion of thrombus formation
- Coatings: thrombin, gelatine, and polyurethane or fibers(synthetic materials Dacron, polyester polyamides, and natural fibers such as silk and cotton) to improve thrombogenicity
- Mechanical occlusion
- Variety of shapes and sizes
- In general, coils should be sized 20 to 30% larger than vessel size

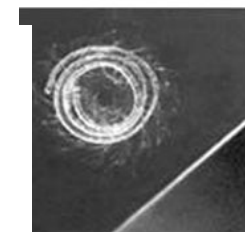
1. Coils range in size from 0.008 to 0.052 inches.
2. Microcoils are typically made of platinum wire from 0.012 to 0.018 inches in diameter.
3. Available coil shapes include J- or C-shaped, helical, conical, tornado, straight, and complex three dimensional (3D) shapes.
4. Coils may be bare or fibered with material such as Dacron, nylon fibers, polyester, wool, silk, or PVA embedded within them to increase thrombogenicity.



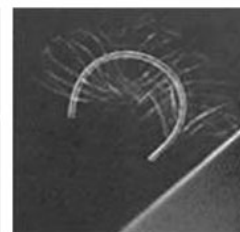
Complex Shape



Straight Shape



Flat Spiral Shape



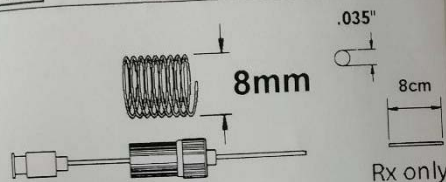
C-Shape



MReye® Embolization Coil

REF IMWCE-35-8-8

REF G20948



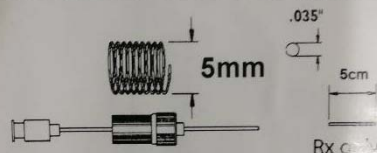
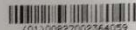
STERILE EO	2020-12-15	⊗	⚠	📖
LOT 6373277	2015-12-15	☀	☂	



MReye® Embolization Coil

REF IMWCE-35-5-5

REF G36405



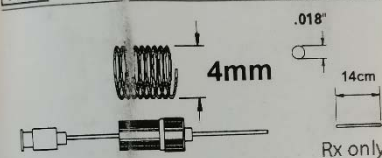
STERILE EO	2021-05-31	⊗	⚠	📖
LOT 6979990	2016-05-31	☀	☂	



MicroNester® Embolization Coil

REF MWCE-18-14-4-NESTER

REF G26988



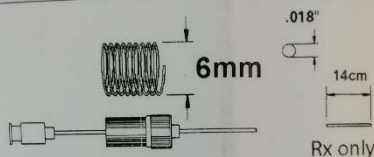
STERILE EO	2021-02-19	⊗	⚠	📖
LOT 6544698	2016-02-19	☀	☂	



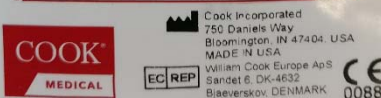
MicroNester® Embolization Coil

REF MWCE-18-14-6-NESTER

REF G26989



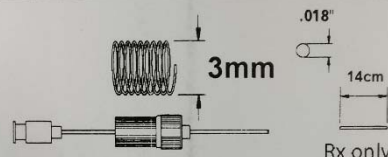
STERILE EO	2021-01-26	⊗	⚠	📖
LOT 6473079	2016-01-26	☀	☂	



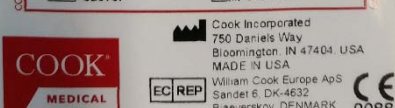
MicroNester® Embolization Coil

REF MWCE-18-14-3-NESTER

REF G26987



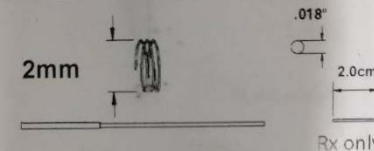
STERILE EO	2021-01-22	⊗	⚠	📖
LOT 6463966	2016-01-22	☀	☂	



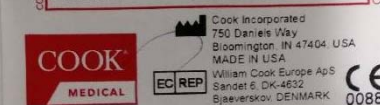
Hilal Embolization Microcoil™

REF MWCE-18-2.0-2-HILAL

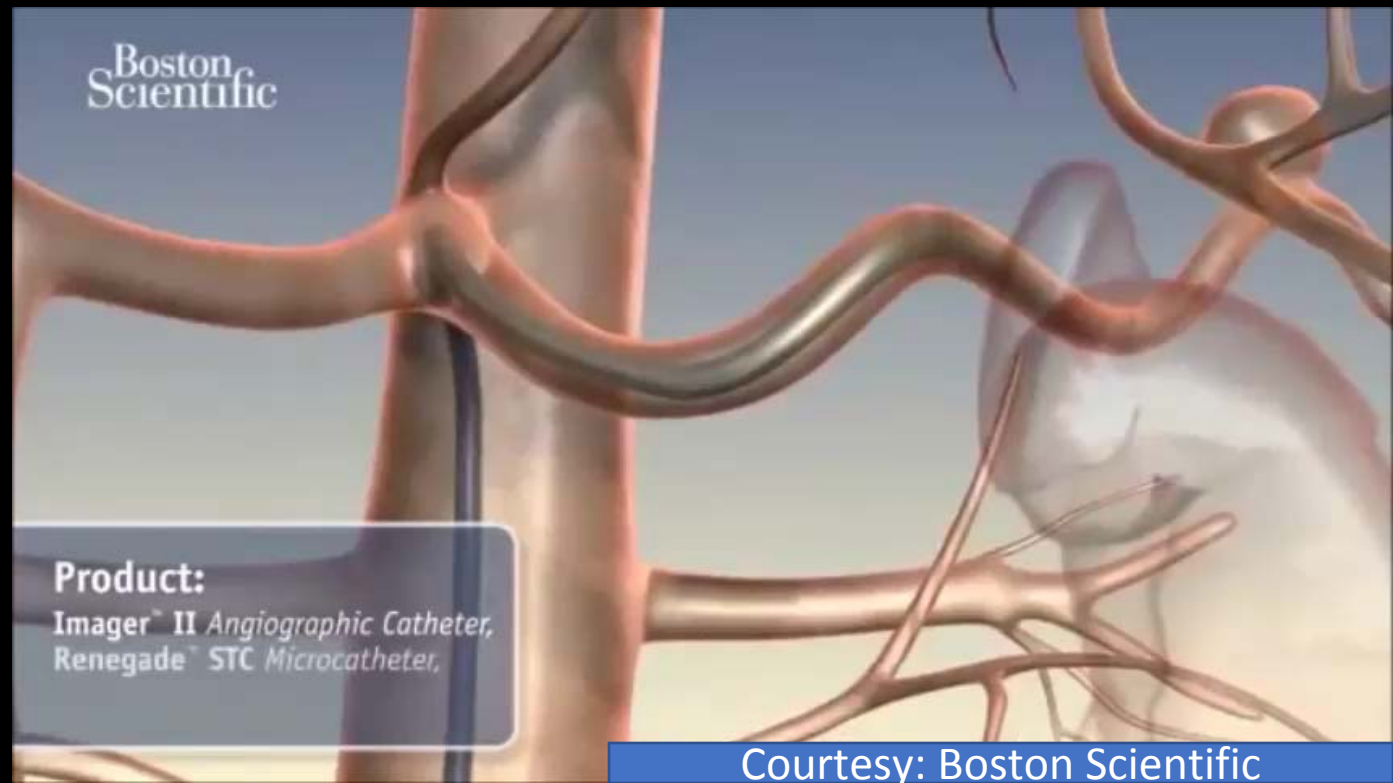
REF G07160



STERILE EO	2019-03	⊗	⚠	📖
LOT 4808311	2014-03	☀	☂	







Boston
Scientific

Product:
Imager™ II Angiographic Catheter,
Renegade™ STC Microcatheter,

Courtesy: Boston Scientific

Coils

Advantage

1. Permanent mechanical embolic agent
2. Variation in size and shape
3. Easy to use
4. Thrombus formation with in 5 min after deployment

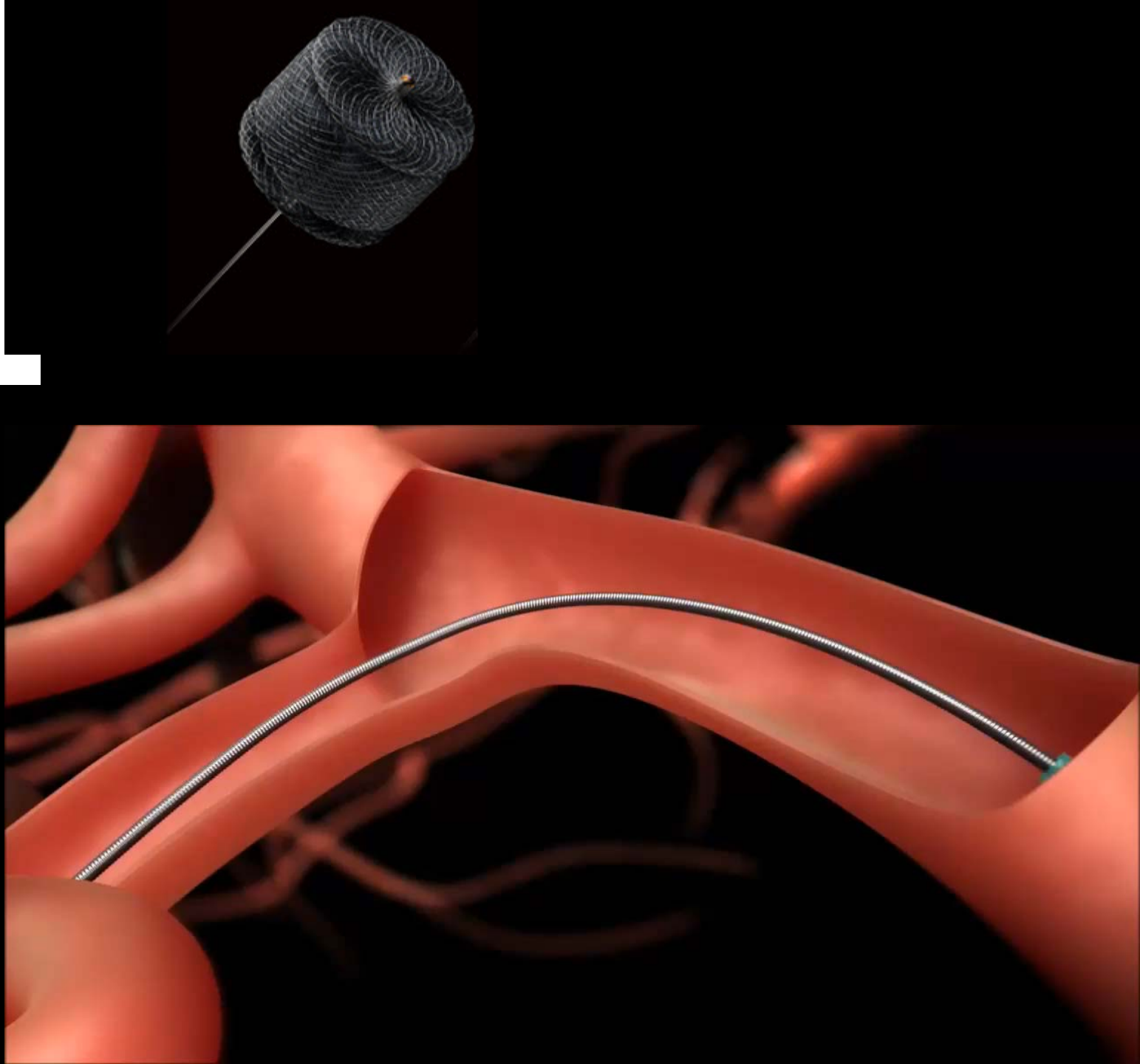
Disadvantage

1. Coil may be inadvertently advanced too far distally.
2. Detachable coils-high cost
3. if target vessel is tortuous, or when using an oversized coil, may result in the catheter backing out

VASCULAR PLUGS

- Relatively new and include a family of expandable nitinol mesh vascular occlusion devices that are derived from septal occluders.
- The 4-,6-,8-mm plugs are 7 mm long and require a deployment catheter with minimum inner diameter (ID) of 5F.
- The 10- and 12-mm diameter devices are 7 and 8 mm long, respectively, and require a 6F guiding sheath.
- Type 1 to 4 depending on shape





VASCULAR PLUGS

Advantage

- 1.Reduces the time of embolization
- 2.Maintaining complete control during positioning and delivery.
3. Provides full cross sectional vessel coverage which minimizes migration and recanalization potential

Disadvantage

- 1.Not suitable for occlusion of small vessels
- 2.High cost
- 3.Require stiff and larger profile assembly

N-BUTYL-2 CYANOACRYLATE (GLUE)

- N-butyl-2 cyanoacrylate is free monomer, which is clear and free flowing.
- When exposed to an anionic environment such as blood or water, polymerization occurs.
- Lipiodol is used as a vehicle and acts as a polymerization retardant.
- Tantalum powder is included to provide radiographic opacification, but also slows initiation of polymerization.
- To avoid unintended polymerization by premature contact with anions, catheter flushes should be performed with dextrose 5% (D5W) in water



Glue

Advantage

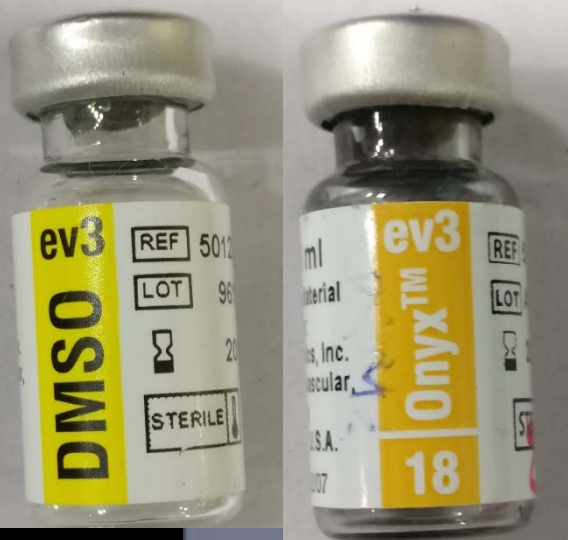
- 1.Reduces the time of embolization
2. Low Cost
3. Instant embolization and complete distal embolization.

Disadvantage

- 1.NBCA requires expertise.
- 2.The catheter can become entrapped in the occluded vessel.
3. Polymerization can spread distally or reflux proximally to the intended location

ETHYLENE VINYL ALCOHOL COPOLYMER (Onyx)

- It is a copolymer of ethylene vinyl alcohol prepared with dimethyl sulfoxide (DMSO) as solvent.
- Tantalum powder is added for opacity.
- On contact with blood, the DMSO diffuses away allowing polymerization of the EVOH, which forms a cast of blood vessels.
- Comes prepared as Onyx 18 and Onyx 34, which differ in viscosity.



PHIL™ System Components



- 1cc of PHIL in pre-filled Sterile syringe
- 1cc of DMSO in pre-filled Sterile syringe
- Catheter specific adapters

✓ IFU

Onyx

Advantage

1. Nonadhesive.
2. Allows for longer injection times and the ability to temporarily suspend embolization.

Disadvantage

1. EVOH include the need for DMSO-compatible catheters and syringes
2. DMSO is toxic, and rapid injection of DMSO can cause vasospasm and necrosis.
3. High Cost
 - *The safe injection rate is <0.3 mL injected longer than 40 seconds

Detergent-Type Sclerosants

- ***Polidocanol***: is effective by altering the endothelium and promoting thrombosis. Used for the small venous malformations and small venous varicosities.
- ***Sodium Tetradecyl Sulfate (Sotradecol)***: damages the endothelium resulting in thrombosis and fibrosis. Can be used in a liquid solution or by creating a foam with air.
- ***Ethanolamine Oleate***: mixture of 5% ethanolamine oleate (synthetic mixture of ethanolamine and acid oleic) and iodized oil (Lipiodol). It is a salt of an unsaturated fatty acid and has been used as a sclerosing agent because it has excellent thrombosing properties

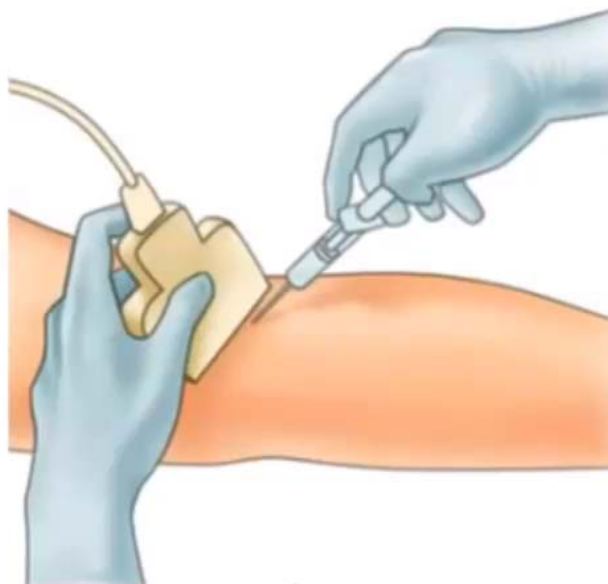


fig.1

FIG 1:

Utilizing ultra sound technology, the varicose vein is located to allow for precision injection of the sclerosant agent.



fig.2

FIG 2:

Once the sclerosant agent is injected into the vein, it causes the varicose vein to collapse.

Thanks