The Yakes AVM Classification System: A Guide To Curative Endovascular Treatment Strategies

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Disclosure
Speaker name: Fiona Rohlfis

- I have the following potential conflicts of interest to report:
  - Receipt of grants/research support
  - Receipt of honoraria and travel support
  - Participation in a company sponsored speakers' bureau
  - Employment in industry
  - Shareholder in a healthcare company
  - Owner of a healthcare company
- I do not have any potential conflict of interest

The Yakes Classification System

- Further refinement of previous Classification systems
- IV AVM Types based on angioarchitecture
- Defines the nidus and is a guide on treatment strategy
- Ethanol and coils
- Based on long experience with AVM

Type I AVM:
A direct artery to vein fistula connection without Nidus

Artery
Vein

Type I AVM:

Artery
Vein
Permanent occlusion using mechanical devices such as coils, detachable balloons, Amplatz plugs
- ethanol, either alone (in small Type I) or in combination with any of the mechanical occluders

Type IIa:
Multiple arteries/arterioles connecting to a typical “nidus” interconnecting vascular tubular structures that then drain into out-flow veins.

Nidus directly accessed via:
- superselective transcatheter arterial approach or
- direct puncture of the feeding arteries immediately proximal to the nidus to deliver ethanol
Same as Type IIa except the “nidus” drains into an aneurysmal single out-flow vein. The Nidus precedes the vein aneurysm.

Multiple in-flow arterioles shunting into an aneurysmal vein that has a single vein out-flow. Fistulae are in the vein wall.

Multiple in-flow arterioles shunting into an aneurysmal vein with multiple out-flow veins. The fistulae (nidus) are in the vein wall.

Permanent Occlusion using:
- DP or retrograde access to the aneurysmal vein with coil packing for nidus ablation, with or without ethanol.
- Superselective transcatheter arterial approach to the nidus or
- Direct puncture immediately proximal to or in the nidus to inject ethanol

Yakes Type IV AVM:
- Definition of AVM is an artery to vein connection without intervening capillary bed
- Diffusely infiltrating the affected tissue
- Other than brain AVM: bleeding occurs if Ulcer is present (no barrier) or if mucosa is involved (bowell)
Physiologic Concept

Arteriovenous fistulas → 100 mmHg

Normal capillaries → 20 mmHg

• The innumerable micro-AVF drain into multiple veins
• The capillary beds also have vein outflow, lower pressure
• Normal post-capillary venous drainage then competes with the arterialized vein out-flow → restriction of normal tissue flow

Physiologic Concept

Arteriovenous fistulas → 100 mmHg

Normal capillaries → 20 mmHg

• Capillary out-flow veins become engorged, backing up blood into capillary beds and then backing up blood to the arterial in-flow
• AVF’s have lower pressure and increased arterial flow compared to the normal capillaries

How to treat

Take advantage of this physiologic state:

50/50% Mixture of Contrast and Ethanol
Dilute ethanol, thicken fluid by increasing viscosity and specific gravity → preferential flow into AVF’s in transarterial injections

Normal arteries, arterioles and capillaries remain intact while AVF’s sclerose

How to access?

How to treat?

Transarterial

Challenge as normal capillaries have to be maintained

Direct Puncture

When to use 50:50 mixture?

Pure ethanol if puncture distal to nutrient arteries

50:50 mixture contrast:ethanol
Additional Benefit of adding contrast
→ injection is visible on fluoroscopy

To consider:
• needs more overall ethanol as it is diluted
• Not efficient in larger vessels but in type IV microfistulas
• Use only non-ionic contrast, ionic contrast solid precipitates

50/50% Ethanol

Purpose
- To describe the efficacy of the Yakes Classification and its application
- To describe the angiographic outcome, cure rate and clinical correlation in patients with complex AVMs

Methods
- Retrospective Single Center (One Operator) Experience
- Included: all AVM patients with a minimum of 1 treatment in the period from April 2013 – October 2017
- All consecutive Yakes treatment sessions included
- Endovascular treatment of AVMs using ethanol augmented by coils

Results

<table>
<thead>
<tr>
<th>Yakes Type</th>
<th>I</th>
<th>IIa</th>
<th>VPD (IIb, IIIa, IIIb)</th>
<th>IV</th>
<th>mixed</th>
<th>acquired</th>
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Angiographic Outcome:
4) 100% Cured: 49
3) 90-99% Markedly Improved: 23
2) 50-89% Improved: 19
1) < 50% No Change: 7
0) Failure or Aggravation: 2

Clinical Outcome:
No Symptoms: 34
Reduced Symptoms: 47
Unchanged: 15
Worse: 4
Failed previous treatments: 23 patients
No previous treatments: 26 patients
49 patients

Complications:
Major: Necrotizing fasciitis, eroding coils rectum pelvis, amputation × 3, Pulmonary Edema
Minor: Wounds, skin breakdown (healing)
No: 61

Conclusion
- The Yakes Classification, based on angioarchitecture and hemodynamics, offers a clear definition of where the AVM nidus is located
- The Yakes Classification determines where to deliver ETOH, in different concentrations, and/or coils with a high rate of curative outcomes
- It is highly effective
- Yakes Type IV describes a new entity