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Nothing to Disclose

The Yakes AVM Classification System And Its Therapeutic Implications In Challenging Cases

Classification of AVMs: The Houdart CNS Classification, The Do Peripheral Classification, and The Yakes Classification
The Yakes AVM Classification System and its Therapeutic Implications

Arteriovenous Malformations: The Yakes Classification and its Therapeutic Implications
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Introduction
Vascular malformations constitute one of the most challenging entities in the practice of medicine to diagnose and treat effectively by whatever endovascular or surgical approaches are employed. These congenital vascular lesions can involve any tissue in the body. The rarity of vascular malformations in the population compounds the problem of treating them. The physician rarely encounters patients with vascular malformations, it is difficult to gain enough experience to optimally treat those patients.

Figure 1
- A diagram for the 4 types of vessels based on tissue branching: "Type I" arteriovenous fistula, "Type II" arteriovenous malformation, "Type III" arteriovenous malformation, and "Type IV" arteriovenous malformation.

Overview
- The Yakes Classification of Intracranial Arteriovenous Fistulae and Malformations of high-flow lesions and The Cho-Do Classification of AVMs of the cerebral
Treatment of Complex AVMs

- Determination of AVM angioarchitecture, important anatomy surrounding the AVM, and endovascular decision making are critical to success or failure.

- Ethanol and fibered coils as embolic agents

- Retrograde vein, transcatheter, and direct puncture approach are used to deliver embolic agents.

Yakes Type I AVM

41 year old female with a Yakes Type I AVF of the Rt. Kidney. Endovascular mechanical occlusion with coils from the arterial side and retrograde vein side proved curative.
Yakes Type IIa AVM

Typical “nidus” (Latin: “nidum” meaning “nest”) vascular angioarchitecture. Ethanol embolization superselectively delivered by transcatheter and direct puncture techniques into the “nidus” itself is curative.

Yakes Type IIa AVM

19 year old female coed diagnosed with a “Pulsatile Mass” in the Lt. Supraclavicular area and mild exercise intolerance.
Yakes Type IIa AVM

43 year old male with Lt. Brain AVM
Spetzler-Martin Grade IV
Yakes Type IIb AVM

In this AVM subtype a “nidus” is still present, however, instead of multiple out-flow veins draining from the nidus, there is a single aneurysmal out-flow vein for drainage from the nidus. Two endovascular approaches are curative for this Type IIb AVM. As in Type IIa AVMs, transarterial and renal direct puncture ethanoid embolizations are curative. Additionally, as will be seen in Yakes Type IIa AVMs & Yakes Type IIb AVMs, transvenous retrograde vein approaches & direct puncture of the vein aneurysm with complete coil packing of it is also curative. Thus, either approach can be curative in Yakes Type IIb AVMs.

Yakes Type IIb AVM

42 year old male with severe Lt pelvic pain. Diagnosed with a Lt pelvic Yakes Type IIb AVM.
Yakes Type IIIa AVM

Multiple in-flow arteries into an aneurysmal vein with single out-flow vein. Ethanol and/or coils can be curative.
Ethanol embolization of arteriovenous fistulas: a primary mode of therapy.
Department of Radiology, Fitzsimons Army Medical Center, Aurora, CO 80045-5001.
First reported in 3 Figures curative Rx of high-flow AVMS/AVF via dominant outflow vein approach using ETOH/coils.

Peripheral arteriovenous malformations with a dominant outflow vein: results of ethanol embolization.
Cho SK, Do YS, Kim DJ, Kim YK, Shin SW, Park KB, Ko JS, Lee AR, Choo SW, Choo JW.
Department of Radiology and Center for Imaging Science, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Korea.
CONCLUSION: Peripheral AVMs with a DOV can be effectively treated with a high cure rate by the use of ethanol embolization alone or in conjunction with the use of coil and/or core-removed guide wire embolization. Successful in all 19 patients.

Treatment of high-flow vascular malformations by venous embolization aided by flow occlusion techniques.
Jackson JE, Mansfield AO, Allison DJ.
Department of Diagnostic Radiology, Royal Postgraduate Medical School, Hammersmith Hospital, Du Cane Road, London W12 OHS, UK.
Also documented success with venous approach in 4 patients with high-flow lesions.

Yakes Type IIIa AVM

32 year old female presents with a pelvic AVM having had prior embo and total occlusion of all lumbar arteries and both internal iliac arteries with glue and coils. Now presents with non-healing sacral skin ulcer, cellulitis, and pelvic pain due to the AVM stealing from the normal tissues.
Yakes Type IIIa AVM

43 year old male with post-prandial intestinal angina and 40 lb weight loss over 3 months. AVM at root of the mesentery supplied by the IMA.
Vein drainage into a single mesenteric vein. Yakes Type IIIa.

Eventual drainage into the Portal Vein.

DSA thru IMA catheter

DSA thru microcatheter advanced thru an 18 g needle percutaneously placed into the mesenteric vein.

18 g needle

Microcatheter

Coils placed into the mesenteric vein compartments

16 GDC coils placed

68 Cook fibered coils placed

Post-coil embolization DSA showing AVM cure.
5 yr IMA DSA F/up showing persistent AVM cure

5 yr arteriographic F/up Portal vein intact

5 yr IMA DSA F/up with Yakes Type IIIa AVM cure

Yakes Type IIIb AVM

Multiple in-flow arteries/arterioles shunting into an aneurysmal vein with multiple out-flow veins. More challenging to occlude with coils or coils/ethanol the as multiple compartment/outflow veins that have AVFs must be treated for complete endovascular treatment.
Yakes Type IIIb AVM

42 year old female patient suffered from excruciating post-coital chest pains. Pain was so severe she went ER. Evaluation by MR discovered an intra-thoracic right paraspinal, extra-pleural large cystic space with AV shunting. Yakes Type IIIb AVM.
Examples of Endovascular Techniques to Treat Yakes Type IV AVMs

Yakes Type IV AVM

Multiple in-flow arteries with innumerable fistulae throughout a tissue admixed with capillary beds. Multiple out-flow arterialized veins force the tissue veins to compete for out-flow and cause venous HTN. A 50-50% mixture of ethanol and non-ionic contrast can be curative in this lesion type.

Yakes Type IV AVM

20 year old female with growing painful mass in Lt shoulder Deltoid muscle admitted for treatment.
Kevin W. Dickey MD, Jeffrey S. Pollak MD, George H. Meier III MD, Donald F. Denny MD, Robert I. White Jr; MD.

“Management of Large High-Flow Arteriovenous Malformations of the Shoulder and Upper Extremity with Transcatheter Embolotherapy.”


Results: In two patients there was no decrease in cardiac output. In three patients, no permanent decrease in AVM size or resolution of pain was achieved. Two patients experienced post-embolization skin necrosis, and one experienced permanent radial neuropathy. nBCA was the primary embolic agent.

Conclusions: Large, high-flow AVMs in the shoulder and upper extremity may be relatively refractory to intravascular treatment because of the diffuse involvement of the soft tissues by the AVM and the lack of a well-defined nidus. Transcatheter embolotherapy in these lesions should be reserved for patients undergoing resection to help decrease intraoperative bleeding. Cure is not possible.

This article points to the enormity of the problem shoulder AVMs present. Neither embolization with nBCA, and nBCA embo with surgery was not curative and was transiently palliative in this patient series.

Lt Deltoid Yakes Type IV AVM

Later arterial phase

Selective Axillary artery branch angio, early phase
Examples of direct puncture embolization in this Yakes Type IV Shoulder AVM

Later arterial phase

Pre-Embo #1 direct puncture

Post-Embo #1a: 3 ml ETOH

Pre-Embo #2 direct puncture

Post-Embo #2a: 3 ml ETOH
Example of direct puncture into the feeding artery supplying the AVM of this Yakes Type IV Shoulder AVM in the same patient, then using 50%-50% ETOH-Non-Ionic contrast mixture to treat that AVM compartment.

Pre-Embo #1 direct puncture into AVM feeding artery

Pre-Embo #1, later phase

Post-Embo #1a: 4 ml ETOH Note preservation of the parent feeding artery as the capillaries remain intact.

Prior to treatment, early phase

Prior to treatment, later phase
Yakes Type IV AVM

5 year old female with “infiltrative” form of AVM involving the entire Rt ear and growing toward the adjacent scalp. Venous HTN skin changes are present causing pain and bleeding symptoms.

Example of innumerable microfistulous AVMs admixed with capillary beds or the tissue would not be viable.