Ethylene Vinyl Alcohol Copolymer in the Treatment of High Flow Arteriovenous Vascular Malformations: Long term Results and Histology

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**DISCLOSURES**

- No financial disclosures
- Off label use
  - Onyx Liquid Embolic System (EV³, Irvine, CA)
- IRB approval

**PURPOSE**

To describe our experience using ethylene vinyl alcohol copolymer (Onyx) in the treatment of high flow arteriovenous vascular malformations (AVM’s)

**METHODS**

**N = 38 PATIENTS**

- Males 12
- Females 26
- Mean age 28.9 years
- Range 1-67 years

- 16 Patients previously treated with other embolic/sclerosing agents before Onyx

**Onyx TM Liquid Embolic System**

- Ethylene-vinyl alcohol copolymer (EVOH)
- Dimethyl Sulfoxide (DMSO) solvent
- Micronized tantalum powder
- Polymer precipitation occurs upon contact with aqueous solution, blood

**METHODS**

- All patients symptomatic – pain
- MRI/MRA prior to treatment
- UTZ as needed pre-treatment to assess lesion visibility
METHODS
• Onyx 18 and/or Onyx 34 used
• Subselective arterial or venous microcatheter techniques
• Direct injection with ultrasound and fluoroscopic guidance - with tourniquet
• Histologic examination tissue explants

RESULTS
AVM Sites
• Upper Extremity 9
• Lower extremity 14
• Chest, Abdominal wall, 6
• Abdomen/Pelvis 9
TOTAL 38

RESULTS
Delivery Routes
• Transcatheter 24
• Direct injection – image guided 5
• Combination 9
38

RESULTS
• Technical Success (37/38) 97%
• Clinical Success (34/38) 89%
Defined: Decreased pain at 6-8 week f/u
• Eventual amputation = 4

RESULTS
• Mean follow-up 56 months
(range 1-348 months)
• Mean follow-up post Onyx 26 months
(range 1-124 months)
• 1 /38 (2.6%) lost to long term follow-up

RESULTS
Complications: 4 patients (10.5%)
• 2 Skin ulceration
  1 required skin graft
• 1 Worsening of pre-existing radiation burn
• 1 Onyx filament to atrium (neonate)
SELECTED CASES

CASE 1
Chest-Abdominal Wall AVM

- Presented following rib trauma  age 17
- Underwent series of 19 embolizations beginning 1983 - variety agents used
- First Onyx treatment 2013  age 50
- Total 5 Onyx treatments
CASE 2

- 1997: Age 4: left calf mass, limp, pain
- 1999: Surgical resection of left medial gastrocnemius – intramuscular hemangioma
- 2004: Age 11 symptoms recur – workup

Case 2

- 8/05: 1st embo – Embospheres, alcohol
- 4/06 – 7/08: 9 embolizations with Onyx
Case 2

MR Pre-amputation 8/08  Amputation 10/08

AVM

H &E Trichrome

Limitations EVOH (Onyx)
- Distal flow into nidus
- Dilute with DMSO
- Radiopacity obscures anatomy on subsequent treatments
  - Oblique injections
  - Embo roadmap

Advantages EVOH (Onyx)
- Permanent embolic
- Associated with minimal post procedure pain
- Minimal skin changes

CONCLUSIONS
- Onyx is safe, durable agent for treatment of high flow AVM’s
- Minimal post procedure pain
- Low complication rate
- Effective palliative therapy for large lesions
- Useful presurgical embolic agent
Thank you

Arteriovenous Malformations

- Management high flow AVM’s problematic
- Variety sclerosing & embolic agents used
- Utilized EVOH copolymer (Onyx) since 2005

RESULTS

- Mean volume used 7.82 cc (6 vials)
- Range: 0.20CCs – 30.0CCs

Peripheral Vascular Malformations
Use of EVOH at UCLA

- 38 Patients received 112 Onyx Rx
- 22 Patients had >1 Onyx Rx
  - Average 2.94 Rxs Onyx per patient

Total number of Patients 107
Total number of treatments 225
**CASE 2**

- 1997: Age 4: left calf mass, limp, pain
- 1999: Surgical resection of left medial gastrocnemius – intramuscular hemangioma
- 12/04: Age 11 symptoms recur – workup
- 8/2/05: first embo – embospheres ethiodol; 2 subsequent embolizations Onyx
- 5/6/06: resection hallucis longus
- 4/07 – 7/08: 7 embolizations Rx Onyx
- 10/10/08 high above knee amputation

**Case 2A**

- LLE High Flow AVM
- Aggressive

- Painful knee age 2.5 years
- Surgical resection age 4.0 years
- Dx “intraarticular hemangioma”
- 8 months later presented to us
- Underwent 6 Onyx embolizations

**CASE 2**

- 8/2/05: first embo – embospheres ethiodol;
- 2 subsequent embolizations Onyx
- 5/6/06: resection hallucis longus
- 4/07 – 7/08: 7 embolizations Rx Onyx
- Significant uncontrolled pain
Case 2A
Onyx and thrombus occluding artery

[Image of H&E and Trichrome/Elastic stains, 12.5X]

Case 2A
occluded artery wall w abundant elastic fibers (black)

[Image of Trichrome/Elastic stain, 100X]

Case 2A
nerve sprouts in adventitia

[Image of Immunostaining, 200X]

Case 2
Final embolization angio 7/08