Endovascular Embolization And Direct Percutaneous Injection In Management Of Craniofacial Arteriovenous Malformation.

Poster No.: C-1821
Congress: ECR 2017
Type: Scientific Exhibit
Authors: W. A. E. Ali¹, H. Seif², A. Hassan², H. Abozaid², M. Abdel Rahman²,¹ ASSIUT/EG, ²Asyut/EG
Keywords: Ablation procedures, Catheter arteriography, Fluoroscopy, CNS, Interventional vascular, Arteriovenous malformations
DOI: 10.1594/ecr2017/C-1821

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR's endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method is strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org
Aims and objectives

Arteriovenous malformations (AVMs) are vascular lesions that present as a direct communication between an artery and a vein without capillary connections but with a tangle of intervening vessels, known as the nidus\cite{1,2}. Extra-cranial AVMs are most commonly found in the head and neck region, more specifically in the scalp, cheek, ear and nose \cite{1,3}. The clinical presentations include cosmetic defects, pain, bleeding and ischemic ulceration \cite{4}. The management of these lesions is challenging because of their unpredictable biologic behavior and high incidence of recurrence if not managed correctly. Different types of embolic agents have been used for the trans-arterial embolization of AVMs lesions, including n-BCA, Onyx, and polyvinyl alcohol (PVA) particles \cite{5,6}. Trans-arterial endovascular embolization of high-flow AVM lesions with PVA particles is generally not effective because of frequent incomplete closure as well as recurrence of the AVM. However embolization with n-BCA is more effective and permanent \cite{7}. Direct-puncture is used for direct access into the vascular nidus or the draining vein \cite{5,7,8} to embolize a larger portion of the nidus. In this study we aimed to evaluate the safety and the efficacy of endovascular embolization and direct injection in management of craniofacial arteriovenous malformation.
Methods and materials

Between January 2012 and December 2015, we treated 10 patients with craniofacial AVM by either trans-arterial or combined trans-arterial and percutaneous (direct) embolization; seven patients were treated by combined trans-arterial and percutaneous (direct) embolization, three patients treated by trans-arterial embolization alone. There were 7 males and 3 female patients and their ages ranged from 14 to 35 years. (Table 1). Trauma was the reported cause in 2 patients, and the other 8 patients had spontaneous lesions.

All patients presented with pulsatile swelling. Nine of them were presented primarily for cosmetic treatment.

MSCT, MRI, Duplex Doppler and angiography and selective internal and external carotid angiograms were performed for patients before treatment. Informed consent was obtained from each patient before the procedure.

The clinical characteristics of the patients and the outcome of the procedures are summarized in the (table 1).

The procedure:

Our target was to gain devascularization of the nidus as much as possible with no intended cure at the first session to avoid complications. We began by trans-arterial embolization through the main feeder, followed by direct puncture of the nidus if needed. The intervals between the sessions ranged from two to four weeks.

The procedure was started by doing right femoral puncture and insertion of 5F introducer sheath, followed by bilateral internal and external carotid angiogram using 5F catheter (Vertebral or Simmonds II curves) to obtain detailed anatomical and hemodynamic information. For doing embolization, we exchanges the diagnostic catheter by a 5F guiding catheter (Guider soft tip, Boston Scientific) into the external carotid artery. A 1.5-1.8F microcatheter (Marathon, Ultra-flow, ev3, or Boston Scientific Renegade HI-FLO Microcatheter Kit 135cm x 10cm) was navigated under road mapping through the supplying artery and advanced as near as possible to the nidus of AVMs with the aid of blood flow. Superselective angiography was performed through the microcatheter to clarify the angioarchitecture and hemodynamics of the nidus. Trans-arterial embolization was performed using a mixture of n-butyl cyanoacrylate: n-BCA (Histoacryl; B Braun Aescloup) and iodized oil (Lipiodol Ultrafluid; Andre Guerbet). n-BCA and Lipiodol Ultrafluid were mixed at the volume ratio of 1:3 or 1:4 according to the position of the catheter tip and flow speed. The microcatheter was flushed with 5% dextrose solution, and then the mixture was injected under monitoring of the digital subtraction angiography (DSA) images. When flow stasis of the feeding artery was obtained, and retrograde filling
of the mixture toward the microcatheter tip was observed, the injection was stopped and the microcatheter was withdrawn. We embolized a single feeder per session, leaving the other supplying branches to visualize the nidus and to do roadmap for direct puncture. The nasal lesion was embolized using PVA particles.

**Direct puncture:**

We selected either the nidus itself or the supplying artery as near as possible to the nidus for direct puncture. A 20G short needle was introduced under guidance of angiographic roadmap or overlay techniques. We started injection of contrast medium before embolization to assess the needle position, filling of the nidus, and the speed of flow to the nidus and draining veins. If there was rapid filling of the venous side we chose to repeat the direct angiogram with manual compression of the rapidly filled veins. If the draining vein could not be occluded with compression, we sometimes used another needle for puncturing this vein and embolized it with high concentration n-BCA (60%-80%) before embolization of the nidus. The nidus was then embolized using 20%-40% n-BCA/Lipiodol mixture that was adjusted according to the flow rate throughout the nidus on the last direct angiogram. We stopped injection if there was flow to the venous side, extravasation or polymerization of the embolizing material, or after injection of 2 ml of the mixture. We stopped further treatment when the nidus was totally devascularized, or when the residual lesion was too small to be accessed either by trans-arterial or direct embolization.
Fig. 19: Video showing Selective external carotid (DSA) showing cirrroid aneurysm of the scalp supplied by superficial temporal artery (STA) and occipital artery (OCA).

© RADIODIAGNOSIS, ASSIUT UNIVERSITY HOSPITAL, ASSIUT UNIVERSITY HOSPITAL - ASSIUT/EG
Fig. 20: Video showing Direct Angiography of the venous varix of the cirsiod aneurysm of the scalp confirm the diagnosis before direct percutaneous embolization

© RADIodiagnosis, Assiut University Hospital, Assiut University Hospital - Assiut/EG
**Fig. 21:** video showing Complete devascularization of the cirsoid aneurysm of the scalp after combined trans-arterial and direct percutaneous embolization

© RADIODIAGNOSIS, ASSIUT UNIVERSITY HOSPITAL, ASSIUT UNIVERSITY HOSPITAL - ASSIUT/EG
Results

Five cases of scalp AVM lesions, the superficial temporal artery (STA) was shared and its bilaterally involvement was seen in 3 lesions. The internal maxillary artery shared in supply one lesion. The posterior auricular artery shared in supply one lesion also. The occipital artery shared in supply 3 scalp lesions.

The right facial artery was involved in facial lesions, right lip and nasal AVMs and the ophthalmic artery was involved in orbital lesion.

Combined trans-arterial and direct embolization was sufficient to devascularize five lesions from six. This is due to good filling of the nidus portion supplied during direct embolization. Only in case (5), near complete embolization was done because the patient refused to complete further sessions of embolization. In nasal AVM (case 7) bilateral trans-arterial embolization using PVA particles was done (24-48) hours preoperative for reconstructive and cosmetic surgery, the role of the embolization in this case was devascularization before operation.

In case (10) with right cheek AVM we used NBCA and ONYX at different sessions.

One patient complained of pulsatile headache before the procedure that resolved completely after the second session of embolization. All patients had pain, at the site of embolization and all of them needed intravenous analgesics.

In cases no (6, 7&8) endovascular embolization was done alone>two of them (6&7) were completely embolized and one case (8) was partial embolized because of fear of the complication of ophthalmic artery embolization.

No major complications were encountered in our series. None of our patients developed skin necrosis after the first session of embolization .Two patients developed focal skin necrosis of the scalp three weeks after the last session of embolization. Case (1) underwent surgical excision of the necrotic scalp because the area of necrosis was fairly large. Case (4) had a small necrotic area which healed by medical treatment without needing surgery. Two other patients developed focal alopecia without skin necrosis and both of them regained their normal hair growth within 6 months.

<table>
<thead>
<tr>
<th>Case</th>
<th>Sex</th>
<th>Site</th>
<th>Branches</th>
<th>Embolic material</th>
<th>Route of embolization</th>
<th>Embolization Result of embolization</th>
<th>No of sessions</th>
<th>Complication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case (1)</td>
<td>Male</td>
<td>19 years</td>
<td>Parietal</td>
<td>Bilateral STA</td>
<td>NBCA</td>
<td>Mixed</td>
<td>Total 3</td>
<td>Painful pulsatile scalp swelling</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Alopecia</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Necrotic Wound</td>
</tr>
<tr>
<td>Case</td>
<td>Sex</td>
<td>Age</td>
<td>Location</td>
<td>Procedure 1</td>
<td>Procedure 2</td>
<td>Status</td>
<td>Complications</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-----</td>
<td>------</td>
<td>----------</td>
<td>-------------</td>
<td>-------------</td>
<td>------------</td>
<td>---------------</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Female</td>
<td>32</td>
<td>Parietal</td>
<td>Bilateral STA</td>
<td>NBCA</td>
<td>Mixed</td>
<td>complete Total 3</td>
<td>No swelling for cosmetic concern and headache</td>
</tr>
<tr>
<td>3</td>
<td>Male</td>
<td>26</td>
<td>Parietal</td>
<td>Bilateral STA</td>
<td>NBCA</td>
<td>Direct</td>
<td>complete Total 3</td>
<td>scalp Alopecia</td>
</tr>
<tr>
<td>4</td>
<td>Male</td>
<td>30</td>
<td>Right temporo-parietal</td>
<td>Rt STA Rt IMA</td>
<td>NBCA</td>
<td>Mixed</td>
<td>complete Total 3</td>
<td>scalp No swelling for cosmetic concern</td>
</tr>
<tr>
<td>5</td>
<td>Male</td>
<td>14</td>
<td>Fronto-parietal</td>
<td>Rt STA Rt PAA</td>
<td>NBCA</td>
<td>Mixed</td>
<td>near complete Subtotal 2</td>
<td>scalp Skin necrosis</td>
</tr>
<tr>
<td>6</td>
<td>Female</td>
<td>33</td>
<td>RT orbital</td>
<td>Rt. Facial artery Rt. OA</td>
<td>NBCA &amp; Onyx</td>
<td>Endovascular Partial Partial 1</td>
<td>Orbital No swelling and eye congestion</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Male</td>
<td>35</td>
<td>Nose</td>
<td>Bilateral FA Bilateral IMA STA</td>
<td>AHA</td>
<td>Endo Vascular</td>
<td>complete Total 1</td>
<td>Nasal No swelling for cosmetic</td>
</tr>
<tr>
<td>8</td>
<td>Male</td>
<td>32</td>
<td>right chin</td>
<td>RT FA</td>
<td>NBCA</td>
<td>Endo Vascular</td>
<td>complete Total 3</td>
<td>Right chin swelling for</td>
</tr>
<tr>
<td>Case</td>
<td>Gender</td>
<td>Age</td>
<td>Side</td>
<td>Artery</td>
<td>Embolization</td>
<td>Procedure</td>
<td>Total</td>
<td>Reason for swelling</td>
</tr>
<tr>
<td>------</td>
<td>--------</td>
<td>------</td>
<td>------</td>
<td>--------</td>
<td>--------------</td>
<td>------------</td>
<td>-------</td>
<td>---------------------</td>
</tr>
<tr>
<td>9</td>
<td>Male</td>
<td>33</td>
<td>Right lip</td>
<td>RT FA</td>
<td>NBCA Mixed</td>
<td>complete subtotal</td>
<td>right lip swelling</td>
<td>No cosmetic concern</td>
</tr>
<tr>
<td>10</td>
<td>Female</td>
<td>26</td>
<td>Right Cheek</td>
<td>RT FA</td>
<td>NBCA&amp;ONYX</td>
<td>complete Total 3</td>
<td>right cheek swelling</td>
<td>No cosmetic concern</td>
</tr>
</tbody>
</table>

**Table(1)**: STA = superficial temporal artery, OA = ophthalmic artery, IMA = internal maxillary artery, OCA = occipital artery, PAA = posterior auricular artery, FA = facial artery, RT = right, LT = left
Images for this section:

Fig. 1

© RADIODYNOSIS, ASSIUT UNIVERSITY HOSPITAL, ASSIUT UNIVERSITY HOSPITAL - ASSIUT/EG
Fig. 2: Fig(1&2) Female patient 26 years old Complaint: Painless swelling in the right cheek and chin, for cosmetic point of view. Involving the right cheek between the right facial artery and vein Patient before embolization with right cheek and lower lip swelling.

© RADIOPERTOSIS, ASSIUT UNIVERSITY HOSPITAL, ASSIUT UNIVERSITY HOSPITAL - ASSIUT/EG
Fig. 4: 3D reformat MSCT angiography shows right facial AVM involving the right facial artery and vein

© RADIODIAGNOSIS, ASSIUT UNIVERSITY HOSPITAL, ASSIUT UNIVERSITY HOSPITAL - ASSIUT/EG
Fig. 3: Enhanced MSCT showing serpentine vascular lesion of the right cheek and right sub mandibular region

© RADIODIAGNOSIS, ASSIUT UNIVERSITY HOSPITAL, ASSIUT UNIVERSITY HOSPITAL - ASSIUT/EG
**Fig. 5:** Fig(5) right external carotid angigram right facial AVM (arteriovenous malformation)

© RADIODIAGNOSIS, ASSIUT UNIVERSITY HOSPITAL, ASSIUT UNIVERSITY HOSPITAL - ASSIUT/EG
Fig. 6

© RADIODIAGNOSIS, ASSIUT UNIVERSITY HOSPITAL, ASSIUT UNIVERSITY HOSPITAL - ASSIUT/EG
Fig. 7: Fig(6&7) show emicrocatheter during injection of the embolizing material. Complete devascularization of the right cheek AVM(arteriovenous malformation) was done.

© RADIODIAGNOSIS, ASSIUT UNIVERSITY HOSPITAL, ASSIUT UNIVERSITY HOSPITAL - ASSIUT/EG
Fig. 8

© RADIodiAGNOSIS, ASSIUt UNIVERSITY HOSPITAL, ASSIUt UNIVERSITY HOSPITAL - ASSIUT/EG
Fig. 9: Fig(8&9) Non Contrast MSCT 3D reformat showing complete embolization of the right cheek AVM

© RADIODIAGNOSIS, ASSIUT UNIVERSITY HOSPITAL, ASSIUT UNIVERSITY HOSPITAL - ASSIUT/EG
Conclusion

Large craniofacial high-flow malformations are rare, and there is no consensus on their treatment. Embolization has become an integral part of the treatment of these malformations. Cure of these lesions may be attained by embolization alone or embolization followed by surgical removal (5). Our results indicate that complete cure or total control of large craniofacial AVMs, with endovascular approach alone is feasible.

Trans-arterial approach is important for diagnostic purpose, partial embolization of the nidus, providing roadmap or overlay guidance to the direct injection, and assessing the degree of devascularization. It is better to direct trans-catheter embolization at the AVM nidus to avoid angiogenesis. However, when we use combined trans-arterial and direct injection embolization approaches, the occlusion of the artery more proximal that slows the flow through the nidus and facilitates the total occlusion of the nidus by direct approach.

Direct embolization provides good devascularization of the larger portion of the nidus than did trans-arterial approach. It permitted safe devascularization of the nidus portion supplied by dangerous arteries that carries high risk if embolized. The percutaneous direct puncture embolization technique can be used alone or in combination with surgical resection as an alternative approach for superficial craniofacial AVM with prominent venous pouch (12).

It was previously reported that endovascular workup does not reduce effective lesion size (9, 10, and 11). However, in our work we noted significant reduction of the lesion size few months after embolization. This decreased the role of surgery in treating such lesions and protected it from excision of the recent or the post-embolization skin necrosis.


