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ORIGINAL ARTICLE

What can 3D CT angiography add in evaluation of facial vascular lesions?

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KEYWORDS

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Abstract *Purpose:* To demonstrate the value of 3D CT angiography (CTA) in the evaluation of facial vascular lesions regarding diagnosis, characterization and full extensions compared to conventional 2D CTA.

Patients and methods: This prospective study included 16 patients with facial vascular lesions with ages that range from 1 to 45 years and mean age of 23 years, patients performed CT angiography (2D and 3D) utilizing the coronal and sagittal MPR and VR techniques. Lesions were evaluated by both 2D and 3D sequences regarding characterization and complete extension including intracranial extension. Our results were correlated with maxillofacial and plastic surgery results.

Results: Among the 16 patients, 7 had hemangiomas, 5 had AVMs and 4 had AVFs. In hemangiomas, 2D successfully evaluated (regarding diagnosis, characterization and full extensions) 5 patients (71.5%) and 2 patients were in doubt regarding diagnosis, while 3D CTA successfully evaluated all the patients (100%). In AVMs, 2D CTA successfully evaluated 4 patients (80%), one patient was in doubt regarding intracranial extension, while 3D CTA successfully evaluated all the patients (100%). In AVFs, 2D and 3D CTA successfully evaluated all the patients (100%). For all cases, diagnostic accuracy of 2D CTA was 81.3%, while diagnostic accuracy of 3D CTA was 100%.

Abbreviations: AVF, arteriovenous fistula; AVM, arteriovenous malformation; CA, conventional angiography; CTA, CT angiography; ECA, external carotidartery; ICA, internal carotidartery; MIP, maximum intensity projection; MRA, magnetic resonance angiography; SOF, superior orbital fissure; VR, volume-rendering.

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Conclusion: CTA offered noninvasive excellent angiographic imaging modality of the facial vascular lesions. The 3D CTA in particular (with high spatial and temporal resolution) provided distinct features that enabled excellent lesion detection, characterization, visualization of feeding arteries and draining veins and complete extensions. The 3D CTA allowed accurate differentiation of hemangiomas from AVMs that is sometimes difficult using clinical examination and 2D CTA. The 3D CTA plays an important role in extension evaluation, treatment planning (through full orientation of vascular tree) and follow up, thus eliminates the need for invasive DSA.

1. Introduction

The complex anatomy of the head and neck can make it difficult for the surgeon to be fully oriented by the vascular lesions in this region. Vascular lesions can be difficult to diagnose and classify. Accurate classification is important because treatments and prognosis vary based on the type of lesion. Diagnosis is based on a combination of clinical features with a variety of imaging techniques, including Doppler US, CT/CTA, MRI/MRA and conventional angiography (1–3). Duplex scanning visualizes superficial lesions and determines flow characteristics. Conventional CT measures bone and soft tissue density, but vascular lesions are poorly visualized, due to a slow image acquisition rate (4–5).

Magnetic resonance imaging (MRI) characterizes soft tissue tumor architecture, but is limited when the tumor involves bone. MR angiography is semi-invasive and accurate but is time consuming and not appropriate in an acute setting and the presence of intramural calcium leads to creation of magnetic field in homogeneities. MRA has many disadvantages like longer imaging time leading to motion and pulsation artifacts, exaggeration of stenosis with inability to depict true lumen of vessels in areas of turbulence (8–11). Angiography is the gold standard for diagnosis but DSA is invasive, time-consuming, traumatic, relatively high cost and carries a small (1.3%) yet significant risk of neurologic morbidity (6,7).

CTA has become clinically useful due to advances in CT image acquisition. With the ability to obtain images in seconds, careful timing of intravenous contrast administration with directed imaging results in capture of contrast within the vascular lesions, as well as feeding vessels and draining veins. CTA with three-dimensional (3D) reconstructions can provide an exquisite overview of many of these lesions. CTA with 3D reformations considered a first-line evaluation and a follow-up tool for treated lesions (12–15).

The development of CT scanning equipment with multiple parallel detector arrays has enabled semi-invasive dynamic visualization of the entire head circulation, maintaining excellent spatial and temporal resolutions. Imaging of AVM's need high temporal resolution of the arteries and veins to depict the feeding arteries, nidus and early draining veins. Today CT angiography is being used in the evaluation of the AVM nidus prior to radiosurgery planning and in follow-up of patients after surgical treatment (12–15).

1.1. Aim of the study

The aim of this study was to demonstrate the value of 3D CT angiography (CTA) in the evaluation of facial vascular lesions regarding diagnosis, characterization and full extensions compared to conventional 2D CTA.

2. Patients and methods

This prospective study was conducted at a private center in Mansoura during the period from May 2009 till November 2011, it included 16 patients (11 were females, 5 were males) with their ages that ranged from 1 year to 45 years with a mean of 23 years. Patients were referred from maxillofacial surgery and plastic surgery clinics of Mansoura University Hospital seeking CTA. Patients' complaint was facial, painless swelling that gradually increased in size. Bruit and thrill were present in AVMs and AVFs, reddish skin discoloration in hemangiomas. History of blunt trauma was found in 2 patients of AVF, other lesions were congenital. Our results were compared with physicians' results. Treatment of hemangiomas was by surgical excision, AVMs and AVFs were embolized and excised. No history of previous embolization or ligation or excision of these lesions.

2.1. Technique of CTA

Scanning of all patients was performed using 16-row General Electric bright Speed CT scanner (General Electric Medical Systems, Milwaukee, WI). An initial scout image was obtained to determine the scan volume. Proper timing is critical to ensure that the arterial system is maximally enhanced with no contamination by venous phase. In our study the optimum delay time was calculated by automated bolus tracking technique in all patients wherein the machine automatically starts scanning once the level of contrast enhancement in the artery (aortic arch) reaches a preset value of 65–70 HU.

A single bolus of 2 ml/kg of scanlux (non-ionic contrast material with 370 mg iodine/mL) was administered intravenously by power injector through a 20–22 gauge cannula located in an adequate superficial vein. Contrast material injected at a rate of 3–4 mL/s. All patients were examined in supine position. Images included head and neck to the thoracic inlet.

Scanning parameters were; section thickness: 0.65 mm/K.V:120/mAs:75–120/pitch: 1–1.5 and gantry rotation time 0.5 s.

About 800–1200 axial images/study were generated. The images were then transferred to an advantage workstation, the axial source data were post processed for display in 2D multiplanar reformat and 3D volume-rendering algorithms techniques. Images included bilateral internal and external carotid arteries and the vertebrobasilar artery. All studies were interpreted by the two radiologists independently.