Contents

List of Figures

List of tables

LIST OF ABBREVIATIONS

AP	: Anteroposterior.
ACA	: Anterior Cerebral Artery.
AChA	: Anterior Choroidal Artery.
ACoA	: Anterior Communicating Artery.
AICA	: Anterior Inferior Cerebellar Arteries.
AVF	: Arteriovenous Fistula.
AVM	: Arteriovenous Malformation.
ATECO	: Auto-Triggered Elliptic-Centric-Ordered.
BVR	: Basal Vein of Rosenthal.
CA:	: Conventional Angiography.
CCF	: Carotid Cavernous Fistula.
CS	: Cavernous Sinus.
CVT	: Cerebral Venous Thrombosis.
CVM	: Cerebrovascular malformation.
CE-MRA	: Contrast Enhanced Magnetic Resonance Angiography.
CCA	: Conventional Catheter Angiography.
DVAs	: Developmental Venous Anomalies.
DWI	: Diffusion Weighted Image.
DSA	: Digital Subtraction Angiography.
GRE	: Gradient Echo.
GDC	: Guglielmi Detachable Coils.
ISS	: Inferior Sagittal Sinus.
ICA	: Internal Carotid Artery.
ICV	: Internal Cerebral Vein.
MRA	: Magnetic Resonance Angiography.
MRDSA:	: Magnetic Resonance Digital Subtraction Angiography.
MIP	: Maximum Intensity Projection.
MCA	: Middle Cerebral Artery.
MDCT	: Multidetector Computerized Tomography.

OS	: Occipital Sinus.
PC	: Phase Contrast.
PCA	: Posterior Cerebral Artery.
PCI	: Posterior Cerebral Insufficiency.
PCoA	: Posterior Communicating Artery.
PACNs	: Primary Central Nervous System Angitis In Childern.
SNR	: Signal to Noise Ratio.
SC	: Sinus Confluence.
SpS	: Sphenoparietal Sinus.
SS	: Straight Sinus.
SMCV	: Superficial Middle Cerebral Vein.
SCA	: Superior Cerebellar Arteries.
SSS	: Superior Sagittal Sinus.
TOF	: Time of Flight.
TR CE	: Time Resolved Contrast Enhanced Magnetic Resonance Angiography.
TRICKS	: Time Resolved Imaging of Contrast Kinetics.
TS	: Transverse Sinus.
VG	: Vein of Galen.
VGAM	: Vein of Galen Aneurismal Malformation.
VA	: Vertebral Artery.
TPA	: Tissue Plasminogen Activator.
PTCBA	: Percutaneous Transluminal Cerebral Angioplasty.
GRAPPA	: Generalized Autocalibrating Partially Parallel Acquisition.

Introduction

Cerebrovascular diseases include some of the most common and devastating disorders: ischemic stroke, hemorrhagic stroke and cerebrovascular anomalies such as intracranial aneurysms and arteriovenous malformations (AVMs). Most cerebrovascular diseases are manifested by the abrupt onset of focal neurological deficit**. (Smith et al., 2004)**

Ischemic stroke most often caused by obstruction of cerebral arteries or veins .Stroke due to obstruction of arteries is substantially more common than stroke due obstruction of cerebral veins. **(Eastwood, 2003)**

Aneurysms are abnormal localized dilatation of any vessel that may be divided into different classification according to morphology, size, location, and etiology. Different types of intracranial aneurysms include 3 general categories: saccular aneurysms, fusiform aneurysms and dissecting aneurysms. Other less common types include: mycotic aneurysms, traumatic aneurysms and oncotic aneurysms. (**Larson, 2003**)

Cerebrovascular angiomatous malformation, also called angiomas, include arteriovenous malformation (AVM) which are of congenital origin and to be differentiating from the simple arteriovenous fistula which is usually due to trauma. Other types of angiomas include cavernous angioma, venous angioma and capillary telangectasia .The above classification is the traditional classification of cerebral vascular malformation. **(David and John, 2003)**

Patients with cerebrovascular angiomatous malformation can present by cerebral stroke with subsequent death or suffering numerous deficits as hemiplegia, loss of vision or speech and several severe cognitive deficits, early diagnosis and treatment prevent patients from permanent invalidization. **(Aktuelle, 1998)**

Dynamic contrast-enhanced magnetic resonance angiography (MRA), was developed primarily for use in the diagnosis of abdominal and peripheral occlusive vascular disorders, however, due to advances in gradient hardware and the development of new pulse sequences, contrast-enhanced MRA can produce the high frame rates needed for intracranial applications as diagnosis of intracranial vascular diseases. ***(Carrol, 2002)***

Techniqual advances in magnetic resonance angiography (MRA) have improved the accuracy of this technique in various clinical situations, such as aneurysms, arterial and venous steno-occlusive diseases, vascular malformations, inflammatory arterial diseases, preoperative assessment of the patency of dural sinuses, and congenital vascular abnormalities. In many centers, MRA has replaced conventional digital subtraction angiography in screening for intracranial vascular disease, because of its non-invasive and non-ionizing character. Several MRA techniques have been developed for the imaging of the intracranial vascular system, such as time-of-flight MRA (TOF MRA), phase-contrast MRA (PC MRA), and contrast-enhanced MRA (CE MRA). ***(Ozsarlak et al., 2004)***

The continuing development of CE MRA techniques and of new contrast agents will lessen the need for intra-arterial angiography in the future and provide more specific method for imaging the intracranial circulation that overcomes the drawbacks of conventional 3D TOF. ***(Sohn et al., 2003)***

Dynamic MRA is based on dynamic acquisition of images and image subtraction; these two principal characteristics produce images comparable to those obtained by conventional catheter angiography (CCA). ***(Gauvrit et al., 2005)***

Concerning AVMs, dynamic contrast-enhanced 3-D MRA helps to noninvasively diagnose and classify arteriovenous dural shunts with regard to identify the arterial feeders, the shunting volume, the location and size of the nidus and venous drainage pattern. However, we found that the most important clinical application was the assessment of shunt occlusion following treatment (i.e. radiosurgery, surgery, or embolization) by determining the absence or presence of early venous filling following injection of contrast agent**.** ***(Reinacher et al., 2007)***

Dynamic contrast-enhanced 3-D MRA is used For preoperative imaging of vascular intracranial tumors e.g.(meningeomas), as detecting the displacement of normal arteries, depiction of tumour feeders, anatomy of the venous system including (the tributaries to the large sinuses, their patency, the location of bridging veins), and the extent of tumour vascularization is obtained using a single sequence**.** ***(Reinacher et al., 2007)*****.**

In cases of patients with acute stroke contrast enhanced MRA is more robust and specific technique in distinguishing between occluded, stenotic and patent intracranial blood vessels in comparable to(TOF

MRA) and even similar to conventional digital subtraction angiography. ***(Nael et al., 2007)***

CE-MRA is less sensitive to flow turbulences and saturation effects than TOF sequences in imaging of cerebral aneurysms because of the high signal intensity within the arterial lumen caused by the T1-shortening effect in CE MRA allowing the imaging of low-flow signals. With a relative insensitivity to coil-related artifacts that may potentially degrade image quality and hinder visualization of a residual neck. Furthermore, the imaging volume may be orientated in the frontal plane, which allows assessment of a large volume compared with TOF MRA in imaging and follow up of intracranial Aneurysms treated with Guglielmi detachable coils. ***(Gauvrit et al., 2006)***.

The aim of this work

The purpose of this study is to elaborate the role of dynamic contrast enhanced MRA as an emerging noninvasive diagnostic tool for better imaging and diagnosis of different intracranial vascular disorders.