CONTRAST ENHANCED MAGNETIC RESONANCE ANGIOGRAPHY VERSUS COLOR DUPLEX ULTRASONOGRAPHY IN ASSESSMENT OF LOWER EXTREMITIES ARTERIAL SYSTEM

ESSAY

SUBMITTED FOR PARTIAL FULFILLMENT OF MASTER DEGREE
IN RADIODIAGNOSIS BY

SEHAM ABD AL RAHIM AHMAD AL NOUTY
M.B.B.CH
Faculty of Medicine, Tanta University

SUPERVISED BY

DR. MOHAMMAD ABD AL AZIZ ALI
PROFESSOR OF RADIODIAGNOSIS
FACULTY OF MEDICINE
AIN SHAMS UNIVERSITY

DR. AHMAD MOHAMMAD GHANDOUR
ASSISTANT PROFESSOR OF RADIODIAGNOSIS
FACULTY OF MEDICINE
AIN SHAMS UNIVERSITY

FACULTY OF MEDICINE
AIN SHAMS UNIVERSITY
2010


قَالُوا سُبْحَانَكَ
لاَ عِلْمَ لَنَا
إِلاَّ مَا عَلَّمْتَنَا
إِنَّكَ أَنتَ
الْعَلِيمُ الْحَكِيمُ
صدق الله العظيم

Acknowledgement

All praise is to Allah and all thanks. He has guided and enabled me by his mercy to fulfill this essay, which I hope to be beneficial for people.

I would like to express my deepest gratitude and sincere appreciation to Prof. Dr. MOHAMMAD ABD AL AZIZ ALI, Professor of RADIODIAGNOSIS, Faculty of Medicine, Ain Shams University for his continuous encouragement, his kind support and appreciated suggestions that guided me to accomplish this work.

I am also grateful to Dr. AHMAD MOHAMMED GHANDOUR, ASSISTANT PROFESSOR OF RADIODIAGNOSIS, Faculty of Medicine, Ain Shams University who freely gave his time, effort and experience along with continuous guidance throughout this work.

Special thanks are extended to members of my family for their constant encouragement and advice whenever needed.

Thanks for all staff of RADIODIAGNOSIS Department whose help and support are greatly appreciated.

List Of content

List Of figure

Figure **page**

List of Abbreviations

MRA	Magnetic resonance angiography
CE-MRA	Contrast enhanced magnetic resonance angiography
CTA	Computed Tomography Angiography
D.U	Duplex ultrasonography
PAD	peripheral arterial disease
ABI	Ankle-brachial Pressure index
MIP	maximum intensity projection
IA-DSA	Intraarterial digital subtraction angiogram
CDU	Colour Doppler Ultrasonography
TBI	Toe-Brachial Index
SNR	signal-to-noise ratio
PAOD	peripheral arterial occlusive disease
CNR	Contrast-to-noise ratio
AAA	Abdominal Aortic Aneurysm

INTRODUCTION

Peripheral arterial disease is a frequent manifestation of systemic atherosclerosis. The prevalence of peripheral arterial disease can be as high as 30% among individuals of advanced age with diabetes mellitus and a history of smoking. PAD can be asymptomatic and clinical presentation can range from intermittent claudication to, in severe cases critical limb ischemia, in whom angioplasty, surgical revascularization, or amputation are usually required ***(Ouriel, 2001; Hirsch et al., 2006)***.

The choice of intervention is governed by the severity of the disease and may involve combined treatments thus patients with limb threatening ischemia require a detailed assessment for a suitable treatment plan to be developed ***(Collins et al., 2007)***.

Intra-arterial contrast angiography is regarded as the reference standard. The drawbacks are those associated with arterial puncture, ionizing radiation, and potential nephrotoxicity of iodinated contrast agents. Several alternative imaging techniques are available, including Magnetic resonance angiography, Computed Tomography Angiography and duplex ultrasonography. These techniques are less invasive than contrast angiography ***(Collins et al., 2007)***.

Contrast enhanced magnetic resonance angiography noninvasively facilitates the accurate and detailed assessment of the peripheral arteries without sedation, catheterization, ionizing radiation, or potentially nephrotoxicity of iodinated contrast agents. CE-MRA has high accuracy for the assessment

of the lower extremity arteries and improves diagnostic performance ***(Koelemay et al., 2001)***.

On the other hand duplex ultrasonography remains an effective and convenient approach for imaging selected arterial segments (e.g. the femoral artery) or for the follow – up of a bypass graft. Duplex ultrasonography provides a non-invasive assessment of the arterial circulation in the lower limb ***(Dellegrottaglie et al., 2007)*.**

Aim of the Work

The aim of this work is to assess role and accuracy of contrast enhanced magnetic resonance angiography as compared to duplex ultrasonography in assessment of lower extremities arterial diseases.

ANATOMY OF LOWER LIMB ARTERIAL SYSTEM

SURFACE ANATOMY OF ABDOMINAL AORTA

The abdominal aorta is indicated by a band about 2 cms wide from a median level 2.5 cms above the transpyloric plane to about 1cm below and to the left of the umbilicus ***(Harold et al, 2004)***.

N.B: The transpyloric plane lies midway between the suprasternal notch and the upper border of the symphysis pubis, useful approximation it lies midway between the umbilicus and the inferior end of the body of the sternum. It corresponds to the hand's breadth of the subject below the ziphisternal joint ***(Harold et al, 2004)***.

BRANCHES: Fig. (1)

They may be classified as ventral (single), lateral (paired), dorsal and terminal. The ventral and lateral are distributed to the viscera, the dorsal branches supplying the body wall, vertebral column and canal and its contents.

Ventral:

1- Coeliac trunk at the level of 12^{th} thoracic or 1^{st} lumbar vertebrae.

2- Superior mesenteric artery at the level of 1^{st} or 2^{nd} lumbar vertebrae.

3- Inferior mesenteric artery at the level of 3^{rd} or 4^{th} lumbar vertebrae.

Dorsal:

1- Lumbar arteries from the 1^{st} to 4^{th} lumbar vertebrae.

2- Median sacral artery arises at its bifurcation to run in the midline over the sacral promontory into the hollow of the sacrum. This is morphologically the direct continuation of the aorta ***(Chummy, 2006)***.

Lateral:

1- Inferior phrenic arteries arise at the level of 12^{th} thoracic vertebra.

2-Middle suprarenal arteries arise at the level of 1st or 2nd lumbar vertebrae.
3-Renal arteries arise at level of 1st or 2nd lumbar vertebrae.

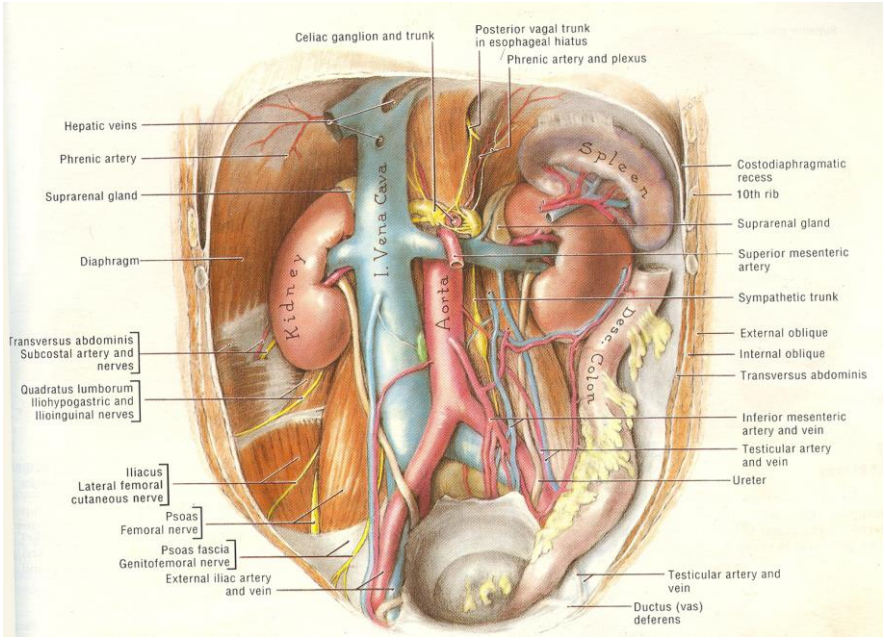

Fig. (1) Abdomiinal aorta and its branches ***(Anne M.R., 2005).***

Terminal:

Common iliac arteries at level of 4th lumbar vertebra.

The common iliac arteries:

They deviate to the left of midline on the body of 4th lumbar vertebra, and each passes to the front of sacro-iliac joint where they bifurcate into external and internal iliac arteries. Thus the right artery is centimeter longer than the left one ***(Harold et al., 2004)***.

The external iliac artery: Runs along the pelvic brim on the psoas muscle, and passes within the inguinal ligament to enter the femoral

sheath. Its two branches are arising at first above the inguinal ligament.

- **The inferior epigastric artery**: supplies the rectus muscle.

-**The deep circumflex iliac artery**: runs above the inguinal ligament to the anastomosis at the anterior superior iliac spine ***(Harold et al., 2004)***.

SURFACE ANATOMY OF THE COMMON AND EXTERNAL ILIAC ARTERIES:

The common iliac arteries correspond to the superior third of line drawn from aortic bifurcation to a point midway between the anterior superior iliac spin and the symphysis pubis. The external iliac arteries correspond to the inferior two thirds of the line which is slightly convex laterally ***(Chummy, 2006)***.

- The internal iliac artery:

Passes downwards and divides into a larger anterior branch and a small posterior one**.**

- The common femoral artery:

Is the continuation of the external iliac artery distal to the inguinal Ligament. The common femoral artery gives of a deep branch, **the profunda femoris**, and medial to the neck of the femur. The continuation of the common femoral artery in the thigh is **the superficial femoral artery**, which runs medial and anterior to the femur ***(Chummy, 2006)***. Is the most significant branch of the common femoral artery because it serves as the main blood supply to the thigh muscles. The profunda femoris and superficial femoral are nearly equal in caliber at their origin.

The profunda femoris artery (Fig. 2):

The profunda femoris divides rapidly into several branches:

1-Medial circumflex femoral.

2-Lateral circumflex femoral.

3-Perforating and muscular branches.

The medial and lateral circumflex femoral branches constitute important collateral pathways when the common, external iliac or common arteries are occluded.

The four perforating branches of the profunda femoris artery descend caudally along the posterior-medial aspect of the femur and obliquely penetrate the adductor magnus muscle to reach the back of the thigh. The terminal branches of these perforating arteries anastomose freely with the small muscular branches of the superficial femoral artery ***(Chummy, 2006)***.

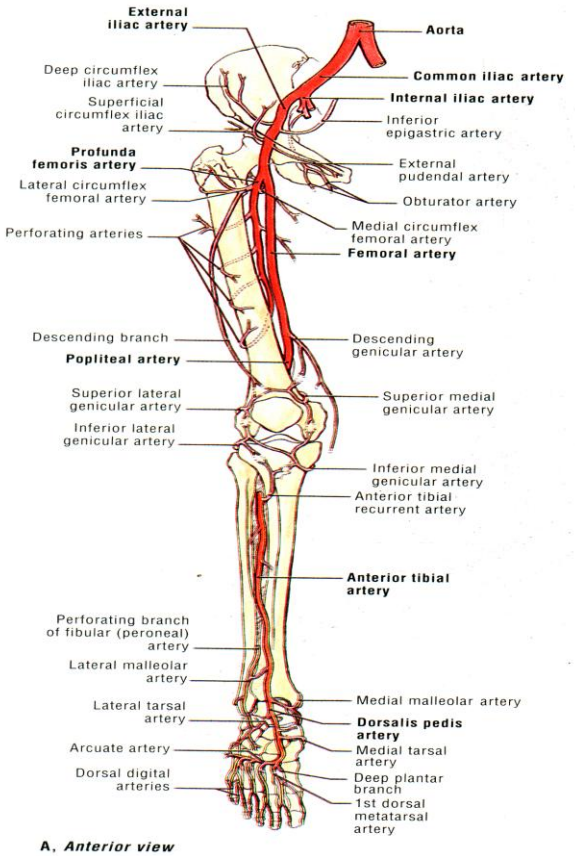

Fig. (2): Arteries of the lower limb (Anterior view) ***(Anne M.R., 2005)***

The superficial femoral artery:

Lies medial to the femur and in the lower third of the thigh runs posteriorly to pass through the adductor canal. As it passes through this tendinous hiatus in the adductor magnus muscle, it becomes the popliteal artery ***(Abrams, 1990)***.

SURFACE ANATOMY OF THE COMMON AND SUPERFICIAL FEMORAL ARTERY: (Fig. 3)

It corresponds to proximal two thirds of a line drawn from the mid-point between anterior superior iliac spine and symphysis pubis to the adductor tubercle with the thigh semi flexed, abducted and externally rotated ***(Harold et al, 2004)***.

Variations:

Rarely, the femoral artery divides distal to the origin of the profunda femoris artery into two trunks which unite again near the adductor opening.

It may be replaced by the inferior gluteal artery, accompanying the sciatic nerve to the popliteal fossa and representing a proximal persistence of the original axial artery. Here the external iliac artery is small and ends as profunda femoris artery ***(Harold et al, 2004)*.**

The Popliteal artery:

The popliteal artery is the continuation of the femoral artery, traverses the popliteal fossa from the opening in the adductor magnus it descends laterally to the intercondylar fossa, inclining obliquely to the distal border of the popliteus, where it divides into the anterior and posterior tibial arteries. This division is at the proximal end of the crural interosseus space between the wide tibial metaphysic and the slender