

**ROLE OF DIFFERENT IMAGING MODALITIES IN
THE DIAGNOSIS OF AORTIC DISSECTION**

THESIS

**SUBMITTED IN PARTIAL FULFILLMENT OF MASTER
DEGREE IN RADIODIAGNOSIS**

BY

FREDDY SAFWAT NAGIEB ELBAIADY

(M.B.,B.CH.)

516.07561
F 5

SUPERVISED

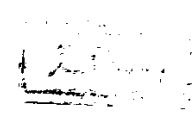
BY

PROF. DR. MOHAMAD SAMY ELBEBLAWY

PROFESSOR OF RADIODIAGNOSIS

FACULTY OF MEDICINE

AIN SHAMS UNIVERSITY

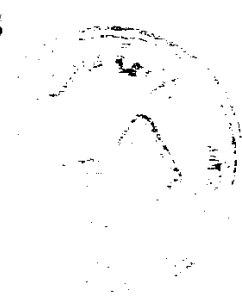


DR. SUSAN BAHIG ALY ELHEFNAWY

LECTURER OF RADIODIAGNOSIS

FACULTY OF MEDICINE

AIN SHAMS UNIVERSITY



**FACULTY OF MEDICINE
AIN SHAMS UNIVERSITY**

1998

DEDICATION



*This work is dedicated to my family:
to my parents who taught me
the very first and most valuable things in life,
for their continuous support, patience and encouragement.
Especial thanks to my brother, Victor, for his great
help and advice in the technical computer work.*



ACKNOWLEDGEMENT

All the praise and adoration to God who gives wisdom to the wise and knowledge to the discerning. Thanks to God by whom we live, we move and we are found.

I would like to express my profound gratitude and sincere appreciation to ***Prof. Dr. Samy El-Beblawy, Professor of Radio diagnosis at Ain Shams university.*** I was so fortunate and privileged to carry this work under his supervision, where I found the most valuable advice and the greatest experience. I thank him over and over again.

I wish to express my gratitude ***to Dr. Susan Bahig ElHefnawy, Assistant Prof. Of Radio diagnosis at Ain Shams university,*** for her continuous support and effective encouragement through out all this work. I owe her more than words of thanks.

TABLE OF CONTENTS

- List of figures	I
- List of tables	IV
- List of abbreviations	V
- INTRODUCTION AND AIM OF WORK	1
<i>REVIEW OF LITERATURE:</i>	
- EMBRYOLOGY	3
- ANATOMY	11
- HISTOLOGY	25
- PATHOLOGY	29
- CLINICAL PICTURE	44
<i>DIFFERENT IMAGING MODALITIES</i>	
- ROLE OF PLAIN RADIOGRAPHY	48
- ROLE OF ANGIOGRAPHY	51
- ROLE OF CT	61
- ROLE OF MRI	76
- ROLE OF ECHOCARDIOGRAPHY	117
- ILLUSTRATED CASES	131
- DISCUSSION	152
- SUMMARY AND CONCLUSIONS	163
- REFERENCES	168
-ARABIC SUMMARY	

List of figures

Figure	Description	page
1	various components of the embryonic aortic arch complex in the human embryos	4
2	adult human aorta and its branches showing the position and relative sizes of the definitive contributions from the various embryonic components	5
3	aortic arch complex of human embryo	6
4	The left aspect of the mediastinum	12
5	Ascending aorta	13
6	Relations of aorta	15
7	display the heart, great vessels and lungs in situ.	15
8	Abdominal aorta and branches	19
9	Aorto-iliac angiogram	24
10	principal architectural features of the larger vessels	26
11	transverse section of a young human aorta showing elastic lamina	27
12	elastic fibers in the tunica media of aorta	28
13	cross section of the wall of the aorta	28
14	large clot in the false channel of ascending aorta	30
15	Autopsy specimen shows an extensive dissection of the aortic root	32
16	A dissecting hematoma in the dissecting aorta	33
17	The DeBakey classification system for aortic dissections.	35
18	The Stanford classification system for aortic dissections.	35
19	A case of Marfan syndrome with aortic dissection	41
20	Plain chest films of aortic dissection	49
21	Plain chest films of Marfan syndrome and aortic dissection	50
22	Retrograde aortogram proximal aortic dissection.	52
23	Aortogram from a patient with Type A aortic	55

Figure	Description	page
24	dissection aortogram from a patient with type III aortic dissection	55
25	Digital subtraction aortogram showing distal aortic dissection	58
26	Normal CT anatomy of thoracic vessels	63
27	CT chest showing dissection of the descending aorta	65
28	CT scan image from a patient with Type A aortic dissection	65
29	Normal aortic anatomy in CT coronal volume- rendered image	72
30	Variant aortic anatomy in CT coronal volume- rendered image	73
31	Aortic dissection in CT coronal volume-rendered image	75
32	Normal transaxial (A) and oblique sagittal (B) ECG- gated SE images of the thoracic aorta	78
33	Normal sagittal ECG-gated image and transaxial GRE images through the proximal ascending aorta.	79
34	Diagram shows the single-section, multiphase mode of the segmented k-space sequence	82
35	Diagram shows the multisection, single-phase mode of the segmented k-space sequence	82
36	MRI images of type B aortic dissection in a 46-year- old man	88
36	MR images of Possible aortic dissection in a 67-year- old man after aortic valve replacement	89
37	Longitudinal MR image showing a proximal aortic dissection in a 55-year-old woman.	92
38	MR images of Aortic dissection, type B showing true	94-
(a-c)	and false channels	95
39	Breath-hold cine MRI in diastole and in systole in	97

Figure	Description	page
	type B aortic dissection.	
40	Cine MR images of a patient with aortic dissection at the level of the celiac and superior mesenteric arteries.	99
41	Sagittal-oblique bright-blood segmented turbo-FLASH magnetic resonance angiographic image of the thoracic aorta demonstrates a type I aortic dissection	101
42	False positive appearance of dissection in a child with congenital heart disease	103
43	ECG-gated transaxial and Sagittal images showing a pitfall in the use of MRI for the diagnosis of aortic dissection	105
44	ECG-gated transaxial and coronal images in a patient with type A aortic dissection.	107
45	intimal flap demonstrated by Cine MR image while not seen in X-Ray angiogram	109
(A-B)		
46	Spin-echo and Cine MR image in coronal plane demonstrate an intramural hematoma	110
47	Normal thoracic aorta in maximum-intensity projection (MIP) image from arterial-phase 3D gadolinium-enhanced MR angiography	112
48	Type A aortic dissection of the aortic root shown by DGE MRA	116
49	Two-dimensional echocardiographic study of a 55-year-old woman with a proximal aortic dissection	118
50	Transthoracic echocardiographic study of a 55-year-old woman with a proximal aortic dissection	123
51	Short -axis TEE image of the descending thoracic aorta in a patient with type B aortic dissection	124
52	Short-axis view TEE image of dissection of the ascending aorta	124
53	Color flow map during systole of TEE image showing normal flow in the true lumen .	125
54	Normal Transesophageal echocardiography image of short-axis view of the ascending aorta.	129

List of Tables

TABLE	DESCRIPTION	PAGE
1	Classification systems of aortic dissection	36
2	CT findings in aortic dissection	66
3	Definition of some MR terms	81
4	Sensitivity of different modalities in diagnosis of aortic dissection	155
5	Detection and classification of thoracic aortic dissection, according to imaging procedures.	156
6	Diagnostic potential of TTE, TEE, X-Ray CT, and MRI for the detection of thoracic aortic dissection	158
7	Identification of Thoracic aortic dissection and associated findings, according to imaging procedures	159
8	Diagnostic performance of imaging modalities in the evaluation of suspected aortic dissection.	161
9	Practical assessment of imaging modalities in the evaluation of suspected aortic dissection	162

List of abbreviations

2D	Two dimensional	MPR	multiplanar
3D	Three dimensional		reformations
A	Artery	MR	Magnetic resonance
AA	Ascending aorta	MRA	Magnetic resonance
Ao	Aorta		angiography
AR	Aortic regurgitation	MRI	Magnetic resonance
CR	Crown Rump		imaging
CT	Computerized	NVS	number of views per
	tomography		segment
DA	Descending aorta	RL	Right
DGE	dynamic gadolinium-	TEE	transesophageal
	enhanced		echocardiography
DSA	digital-subtraction	TL	True lumen
	angiography	TR	repetition time
FC	False channel	TTE	transthoracic
Fig	Figure		echocardiography
GRE	gradient-recalled		
	echo		
I	Intimal flap		
Lx	Left		
LV	Left ventricle		
MIP	maximum-intensity		
	projection		

INTRODUCTION

Aortic dissection is a life-threatening disease with a high mortality in the first hours. The diagnosis must be established as promptly as possible and a high index of suspicion is needed. Then a thorough evaluation of the patient is necessary for an adequate clinical decision making, (*San Roman et al., 1996*).

The radiologic assessment of patients suspected of having an aortic aneurysm must be based on an understanding of the treatment options and how these are to be employed in any clinical setting. The diagnosis of dissection must be quickly confirmed (*Petasnick.1991*). On the other hand, if left untreated, the disease is often rapidly fatal (*Anagnostopoulos et al.,1972*).

Clinical diagnosis of Acute aortic dissection is not always easy as the condition may mimic many other diseases in their symptoms and signs including Myocardial infarction, Pericarditis, acute cholecystitis and inflammatory conditions involving costochondral region.

Although the plain radiographic findings are rarely diagnostic , a chest radiograph should be obtained in all patients suspected of having an aortic dissection. An abnormal chest radiograph may lend support to the diagnosis of aortic dissection.

After advent newly developed imaging modalities, diagnosis for aortic dissection had been extremely easier as compared with at the time when we had diagnosed this lesion solely by angiography (*Takamiya et al., 1996*).

Aortic dissection may be imaged using different radiological modalities and techniques including radiography, aortography, magnetic resonance imaging, ultrasound and Each technique has unique advantages for initial diagnosis, confirmation and follow-up.

In recent years, ultrasound, computed tomography and magnetic resonance imaging have seen increased use for diagnosis of condition (*Dowd SB et al., 1996*).

Each modality will be evaluated according to its ability to enable correct diagnosis of the presence and extent of dissection as well as its role in treatment planning particularly when surgical intervention is contemplated.

Aim of work

The aim of work is to assess the role of different diagnostic radiological modalities in diagnosis of aortic dissection.

Embryology Of Aorta

Apart from the aortae none of the main vessels of the adult arise as single trunks in the embryo. Along the course of each vessel a capillary network is first laid down and by selection and enlargement of definite paths in this, the larger arteries and veins are defined. The branches of main arteries are not always simple modifications of the vessels of a capillary network but arise as outgrowths from the enlarged stem.

As mentioned, subsequent to head fold formation each primitive aorta consists of ventral and dorsal parts which are continuous through the first embryonic aortic arch. The dorsal aortae run caudally, one on each side of the notochord, but in the fourth week they fuse from about the level of the fourth thoracic to that of the fourth lumbar segment to form a single definitive descending aorta. Although in many animals paired ventral aortae arise from the truncus arteriosus and course headwards on the ventral surface of the pharynx, in the human embryo the ventral aortae are fused and form a dilated aortic sac. the first aortic arches run through the mandibular arches, and caudal to them five additional pairs are developed within the corresponding branchial arches so that in all six pairs of aortic arches are formed (*Fig.1*). the fifth arches are atypical and probably transient, at most, in mankind (*Collins P, 1995*).

Caution should moderate unqualified use of the term *aortic arch(es)*. The embryonic arches are paired bilateral series joining the ventral aortae (or their fused expanded homologue) with the dorsal aorta of its side after traversing the core of a branchial arch. In contrast the definitive aorta consists of ascending aorta, aortic arch and descending (thoracic and abdominal) aorta-all parts of a single vessel in the mature state (but derived from multiple embryonic sources) (*Fig.1,2&3*) (*Collins P, 1995*).

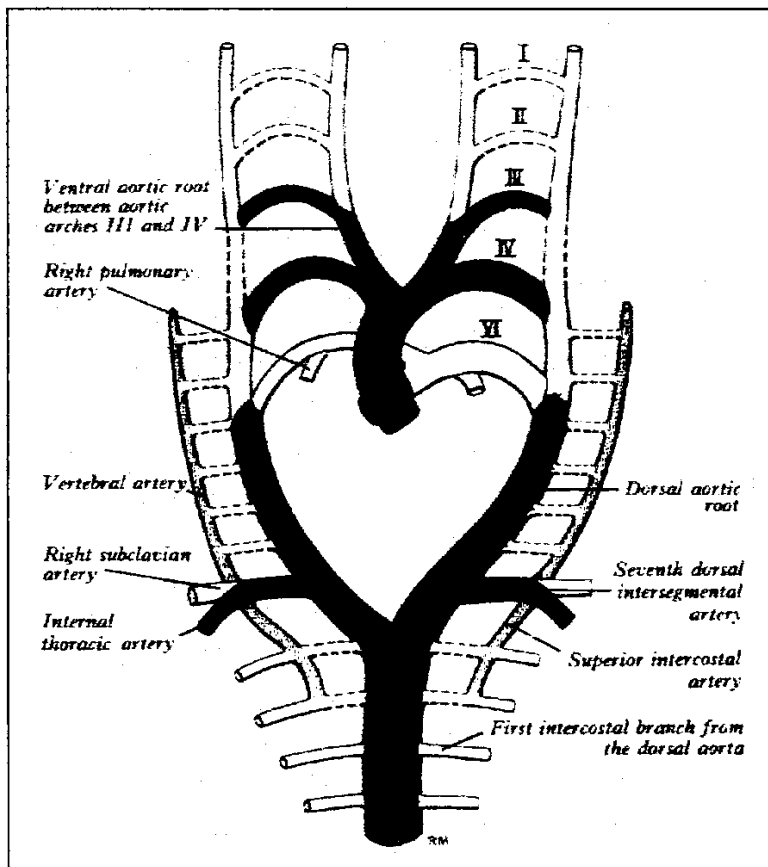
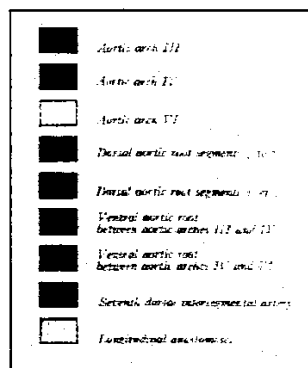


Fig.1 Schematic diagram showing the various components of the embryonic aortic arch complex in the human embryos. Interpreted lines indicate structures, which do not persist in normal development. Roman numerals refer to the branchial arches concerned, and Arabic numerals indicate the metameric body segments (After Gray's, 1993).



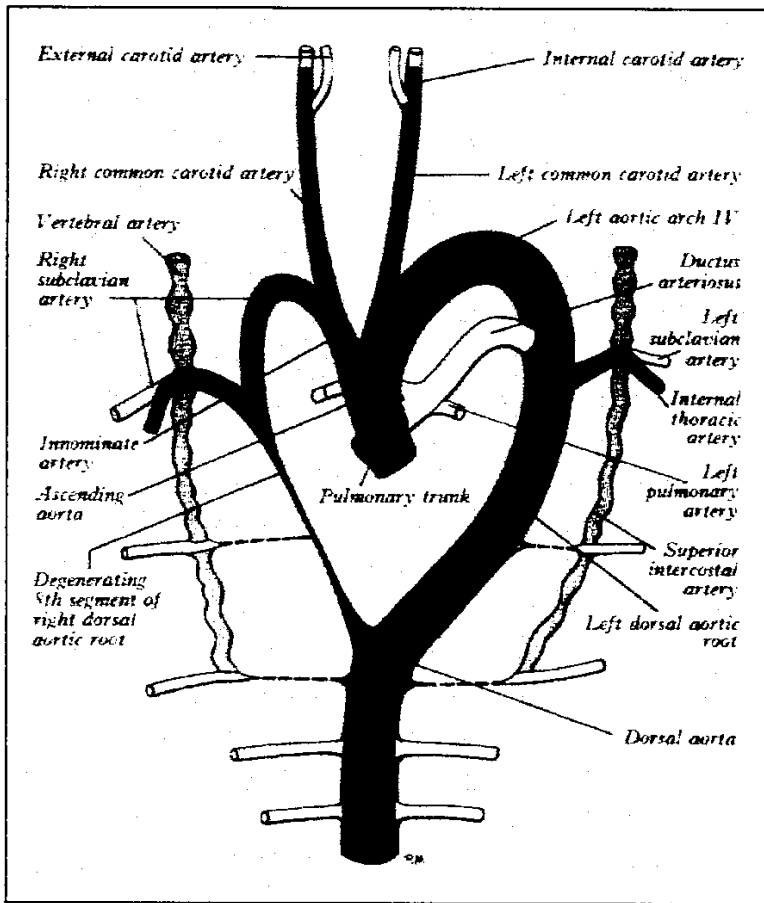


Fig.2 Diagrams of the adult human aorta and its branches viewed from the left ventrolateral aspect, showing the position and relative sizes of the definitive contributions from the various embryonic components shown in (Fig 1-A&B). (After Gray's, 1993)

