



45TH
 45th Annual International Congress of the
 EGYPTIAN SOCIETY OF CARDIOLOGY
CardioEgypt 2018

THE ROLE OF MRI IN CONGENITAL
 HEART DISEASE

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AGENDA

- INTRODUCTION.
- CHALLENGES IN PEDIATRIC POPULATION.
- CLINICAL INDICATIONS FOR MRI EVALUATION IN CHD.
- IMAGING TECHNIQUES.
- A cyanotic heart disease.
- Cyanotic heart disease.
- FUNCTIONALLY SINGLE VENTRICLE.
- FUTURE DIRECTIONS.
- CONCLUSION.



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INTRODUCTION

- Congenital heart disease has an incidence of 6-8 per 1000 in neonates.
(Hoffman & Kaplan 2002)
- Improvements in diagnosis and treatment have led to an increasing of prevalence of patients with congenital heart disease in the general population.
- Recent population data demonstrates that almost 90% of patients born with congenital heart disease have the prospect of surviving into adult hood.
(Moons et al. 2010)



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Introduction

- Echocardiography remains on the imaging frontline for pediatric and adult patients with congenital heart disease.
(Warnes etal.2008)
- Cardiovascular MR provides a powerful investigative tool, giving morphologic and hemodynamic information that echocardiography and catheterization alone can't provide.
(Moons etal.2010)



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CHALLENGES

- Small size of the heart and blood vessels.
- Fast heart rate.
- Arrhythmias.
- Difficulty in breath holding.



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CHALLENGES



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CLINICAL INDICATIONS

Patient group	Information sought
Aortic arch abnormalities	Aortic arch morphology
Coarctation	LV function and mass
Interrupted arch	LV outflow tract status
Pre- and post-repair	Aortic valve function and flow assessment
Aortic arch connective tissue disease	Aortic arch morphology
	Aortic dissection and compliance
	LV volume, function and mass
	LV outflow tract
Univentricular heart pre-BCCPC (including Norwood I)	Pulmonary artery morphology
	Aortic arch morphology
	Ventricular volume and function
	Valvular function and flow assessment
Univentricular heart pre-TUPC (including Norwood II)	^a Agular venous pressure measurement, under GA
	Pulmonary artery morphology
	Aortic arch morphology
	Ventricular volume and function
	Valvular function with flow assessment
	Quantification of collateral flow
Tetralogy of Fallot with BT shunt	RV outflow tract morphology
	Pulmonary artery morphology
PA/VSD, DORV, common arterial trunk	RV outflow tract morphology
	Pulmonary artery morphology
	Pulmonary artery morphology
	Aortic arch morphology
	Ventricular volume and function
	Valvular function with flow assessment
TGA—post arterial switch assessment	Pulmonary vein morphology and flow
	Pulmonary artery flow
Pulmonary vein abnormalities	



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CLINICAL INDICATIONS

Patient group	Information sought
Regurgitant valves	Outflow tract morphology
	Valve morphology and function
	Forward and regurgitant flow quantification
	Ventricular volume and function
ASD, VSD shunt	Defect position and size
	Net shunt quantification (arterial flow)
	Ventricular volume and function
PAPVD	Pulmonary vein morphology
	Net shunt quantification (arterial flow)
	Ventricular volume and function
Pulmonary valve stenosis	RV outflow tract morphology
	Pulmonary artery morphology
	Valvular function with flow assessment
	Ventricular volume and function
Branched PA stenosis	RV outflow tract morphology
	Pulmonary artery morphology
	Valvular function with flow assessment
Repaired tetralogy of Fallot (including conduit patients—e.g. PA/VSD, post-Rastelli operations)	RV outflow tract morphology
	Pulmonary artery morphology
	Ventricular volume and function
	Valvular function with flow assessment
	Coronary artery position
Repaired common arterial trunk	RV outflow tract morphology
	Pulmonary artery morphology
	Ventricular volume and function
	Valvular function with flow assessment
TGA—post arterial switch operation (Mustard and Senning operations)	Systemic RV volume and function
	Aortic valve morphology and function
	Valvular function with flow assessment
TGA—post arterial switch operation	RV outflow tract morphology
	Pulmonary artery morphology
	Aortic arch morphology
	Ventricular volume and function
	Valvular function with flow assessment
	Coronary artery position
Aortic arch outflow or repaired CoA	Aortic arch morphology
	LV function and mass



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CLINICAL INDICATIONS

Patient group	Information sought
Univentricular—Fontan / TCPC	Fontan pathway morphology Pulmonary artery morphology Aortic arch morphology Ventricular volume and function Valvar function with flow assessment Quantification of collateral flow
Ebstein anomaly	Tricuspid valve leaflet morphology and function Right atrial volume RV volume and function Quantification of net forward flow Quantification of ASD shunt
Complex anatomy—any	3D morphology: connections, outflow tracts Pulmonary artery morphology Aortic arch morphology Ventricular volume and function Valvar function with flow assessment Quantification of net shunt
Anomalous coronary arteries	Coronary morphology Myocardial scar Ventricular volume and function Myocardial perfusion

Tetralogy of Fallot

- 1 VSD (high)
- 2 Overriding aorta
- 3 Pulmonary stenosis (infundibular)
- 4 RV hypertrophy

ToF Surgery

- Closure of VSD
- RVOT augmentation
 - Infundibulectomy
 - Transannular patch repair
 - RV-PA conduit

Post-op MRI Evaluation

- RV enlargement (EDV)
- Residual/recurrent RVOT obstruction
- Pulmonary regurgitation
- Branch PA stenosis
- Left PA kinking
- Residual/recurrent VSD

RV Enlargement




RV LV

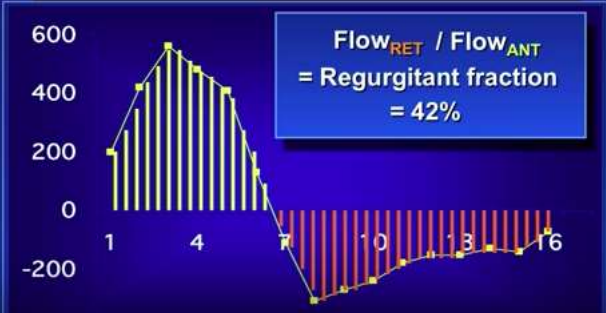
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Tetralogy of Fallot Surgery Pulmonary Regurgitation



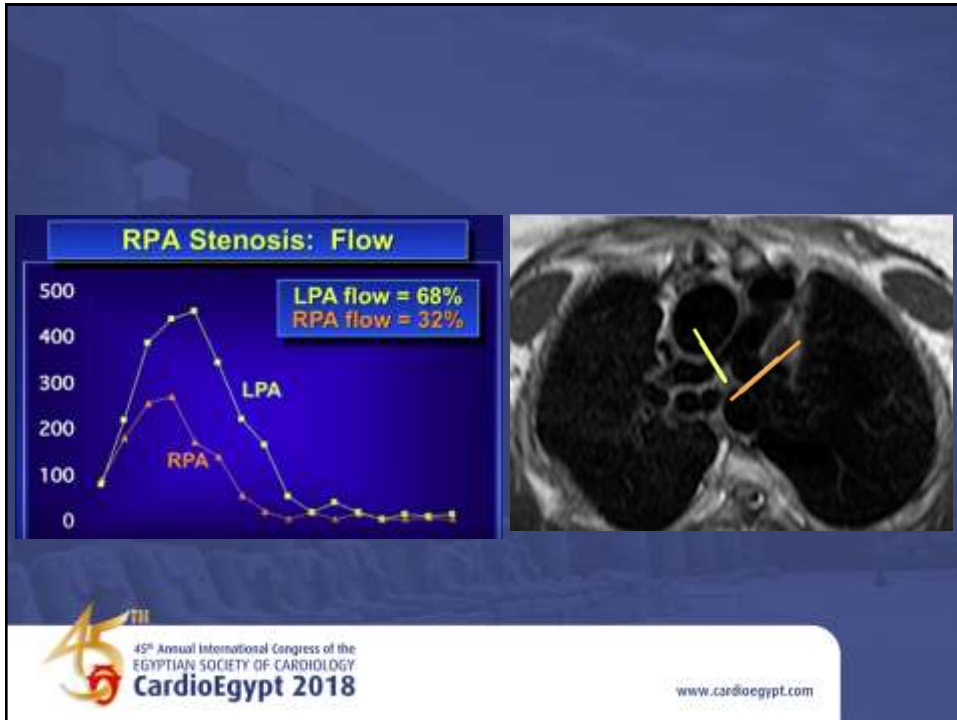
PA
RV



Flow_{RET} / Flow_{ANT}
= Regurgitant fraction
= 42%

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Post-op: Prognosis

The MRI scan shows a cross-section of the heart. A yellow arrow points to the RV (right ventricle). The RV appears smaller than the LV (left ventricle), which is consistent with RV myocardial fibrosis.

- RV myocardial fibrosis
- DHE associated with poor prognosis
- LV ejection fraction
- Decrease associated with poor prognosis

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Transposition of Great Arteries

- Complete transposition
 - LV to PA
 - RV to aorta
- Post-surgical
 - Arterial switch -- PA stenosis
 - Baffle -- RVH, stenosis, clot, leak



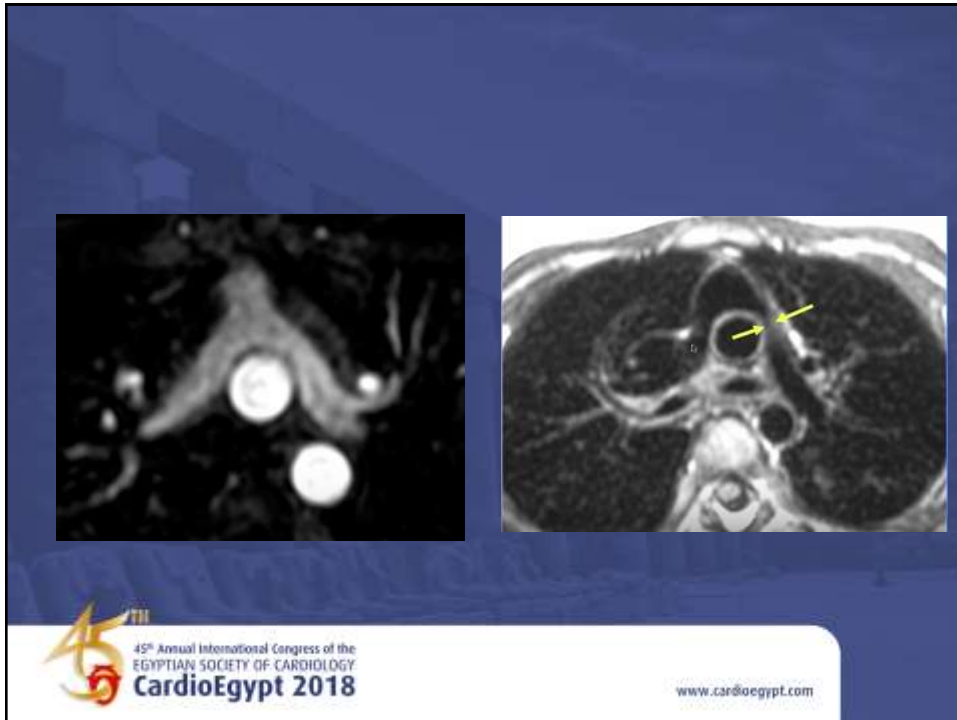
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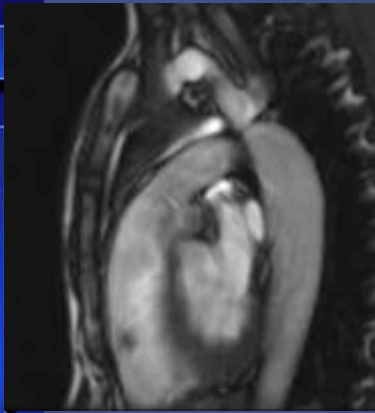
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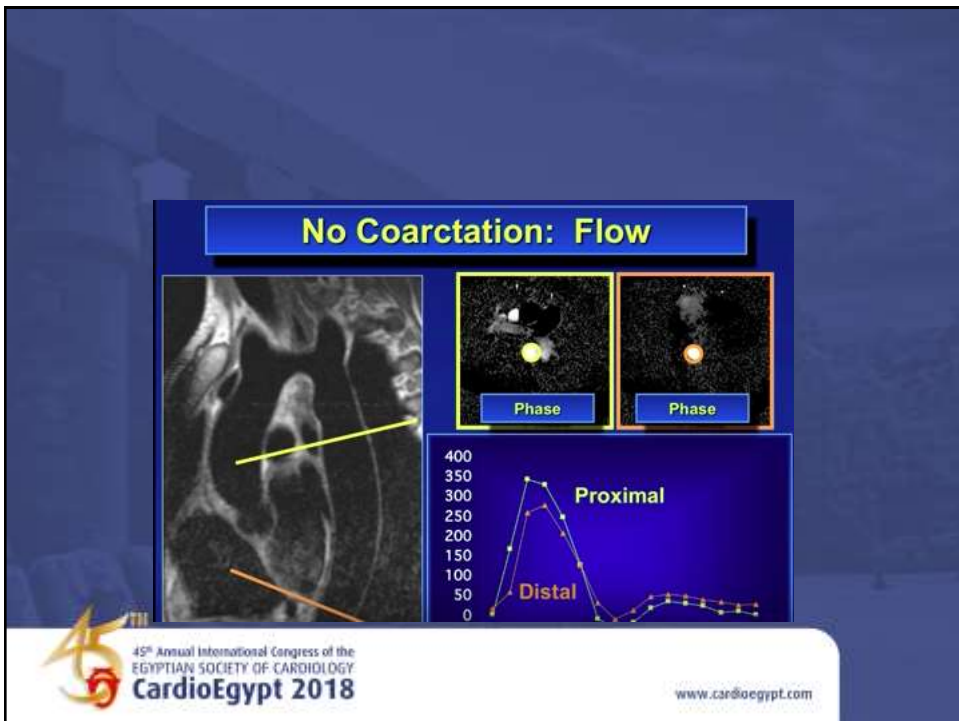
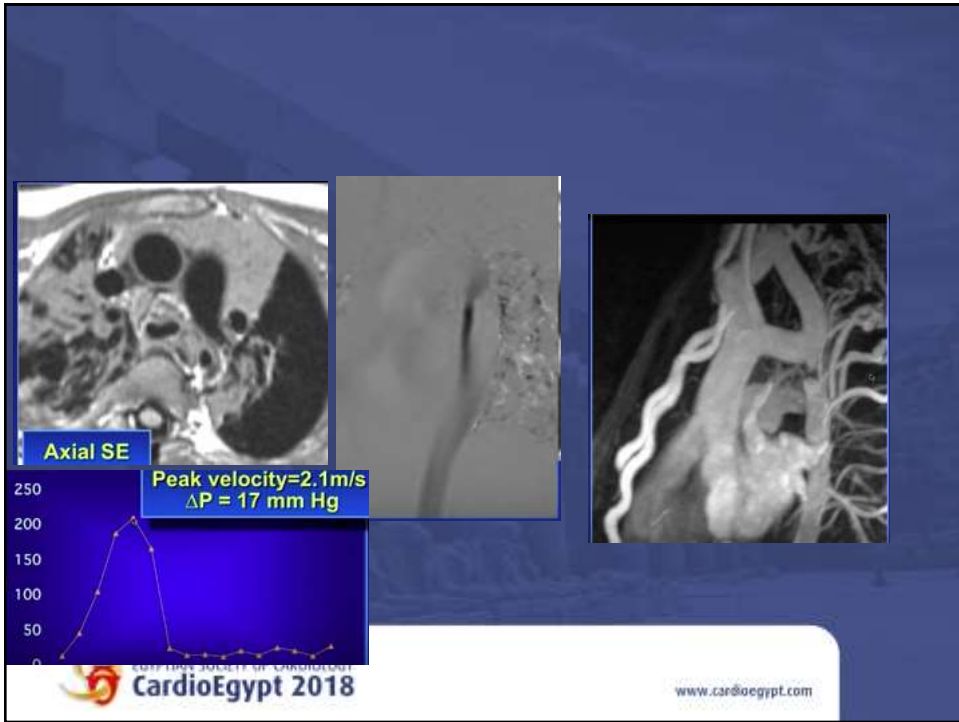
Coarctation: Role of MRI

- Site, severity, extent of narrowing
- Functional significance
 - Pressure gradient
 - Collateral flow
- Post-treatment evaluation
 - Change in collateral flow
 - Recurrent coarctation
 - Patch aneurysm



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Severe Coarctation: Flow

Increase = 85%
(collateral flow)

Distal

Proximal

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HYPOPLASTIC LEFT HEART SYNDROME

a

b

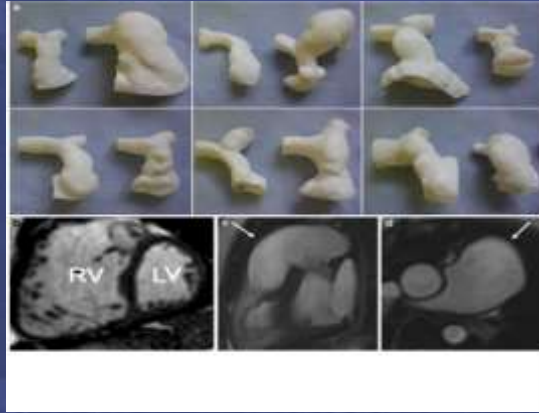
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d

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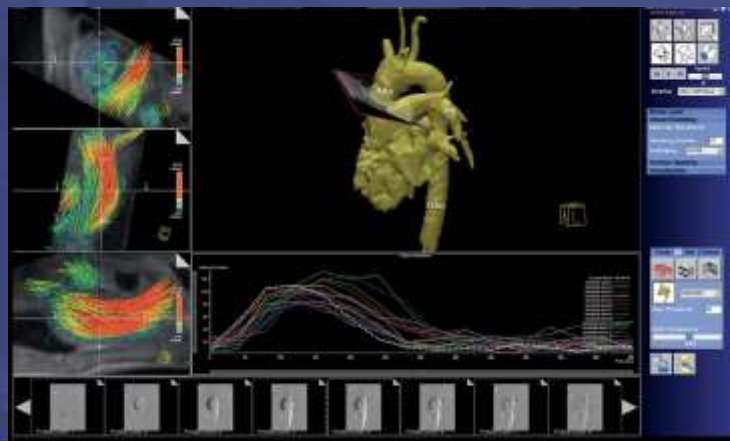
ADVANCES IN MR IMAGING



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ADVANCES IN MR IMAGING



CONCLUSION

- Cardiovascular MRI assessment is a crucial part of the diagnostic workup of both adult and pediatric congenital heart disease.
- Cardiovascular MRI should be used in conjunction with other imaging methods (echo, CT, cardiac catheterization) to provide comprehensive assessment of the patient.
- Protocolisation of MR data acquisition can provide a thorough assessment in all patients.

CONCLUSION

- Newer techniques can provide assessment of coronary arteries anatomy, reversible ischemia and myocardial fibroses.
- Expert review is necessary in the majority of cases.



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