UNMASKING THE COLLATERALS: UNDERSTANDING MAPCAS IN TETRALOGY OF FALLOT

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Introduction

- Major aortopulmonary collateral arteries (MAPCAs) are congenital heart defects consisting of non regressed systemic-to-pulmonary embryologic connections from the aorta or its branches to the pulmonary arterial vasculature.

- MAPCAs augment pulmonary flow in cardiac lesions with compromised antegrade pulmonary arterial blood flow, such as pulmonary atresia with ventricular septal defect (PA-VSD), tetralogy of Fallot, and other cardiac diseases.

- Embryologically, MAPCAs are presumed to be persistent segmental arteries.

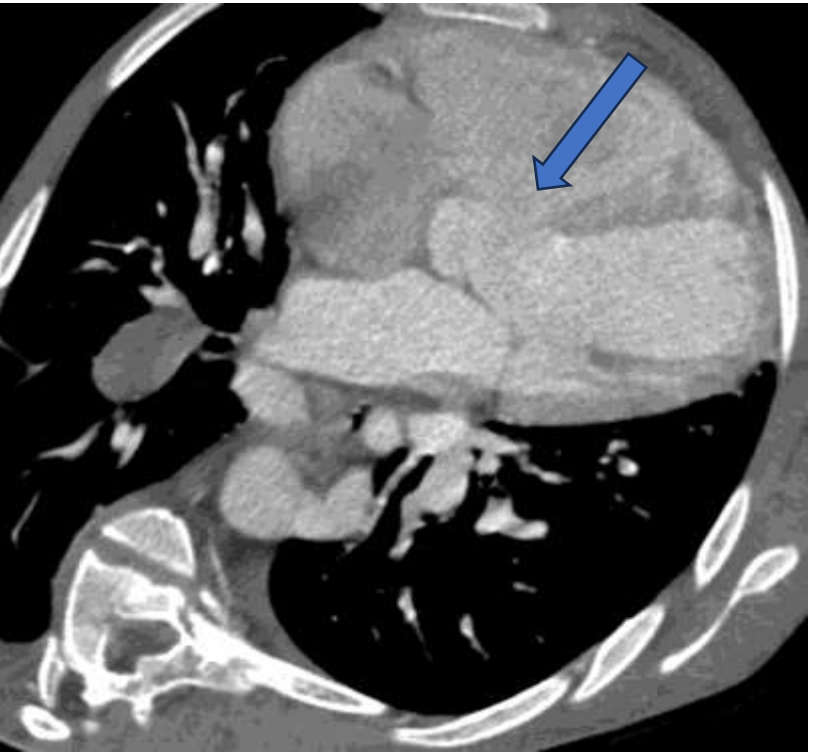
- MAPCAs can be imaged with CT and MRI, and such imaging findings are important for surgeons and interventionists.

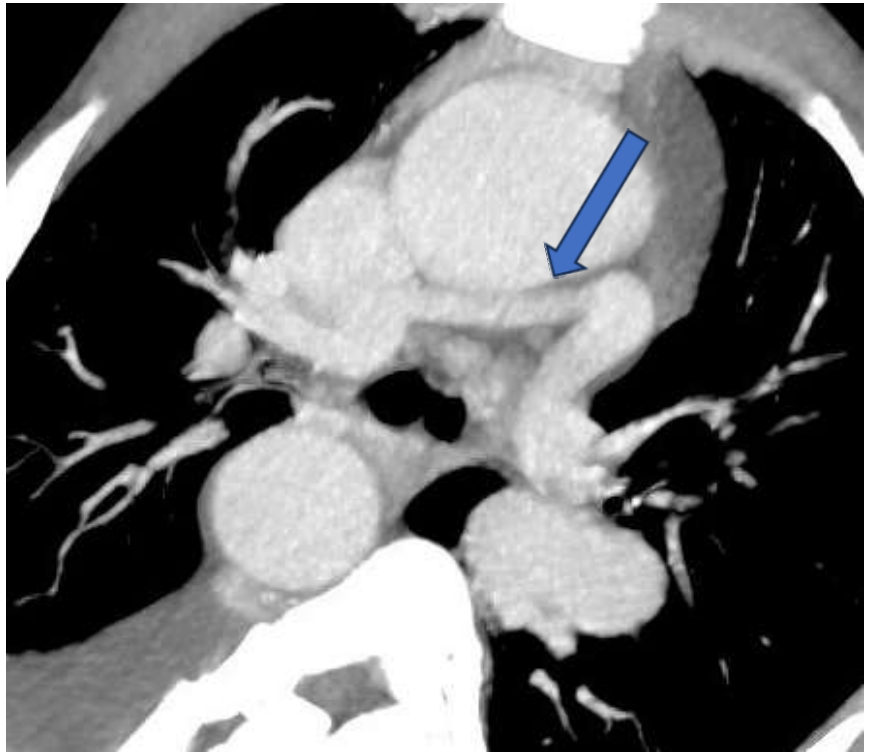
- This review highlights the role of reporting certain critical features of MAPCAs at CT which will help to facilitate management decisions for systemic-to-pulmonary collateral vessels observed in patients with congenital heart disease.

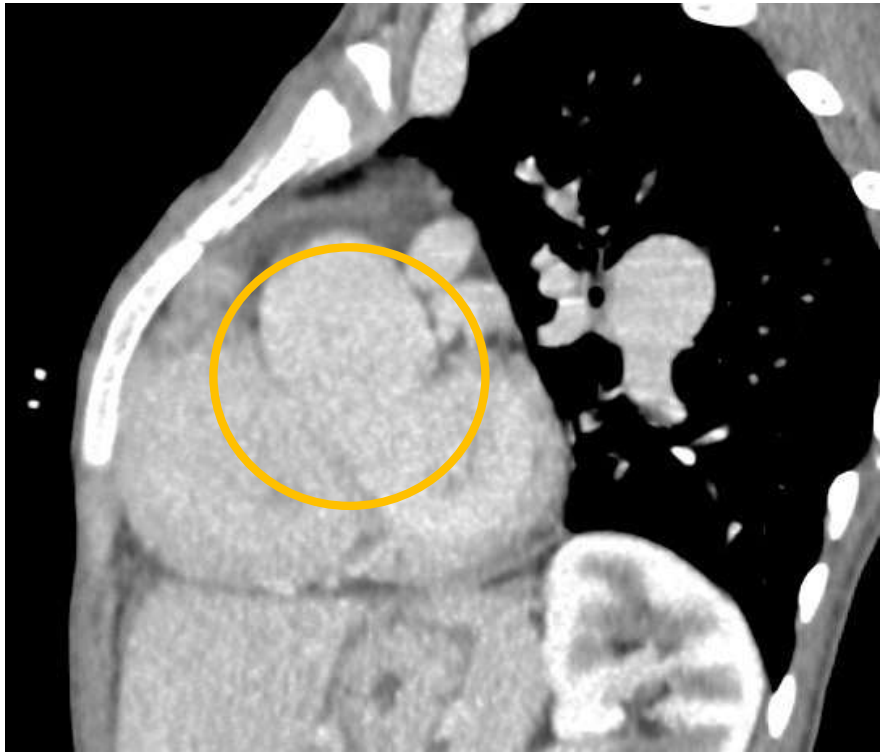
Case

<u>Clinical profile</u>:

- ✓A 20 years old male patient came with complaints of right sided chest pain, cough with expectoration for 1 week.
- ✓5-6 episodes of hemoptysis.





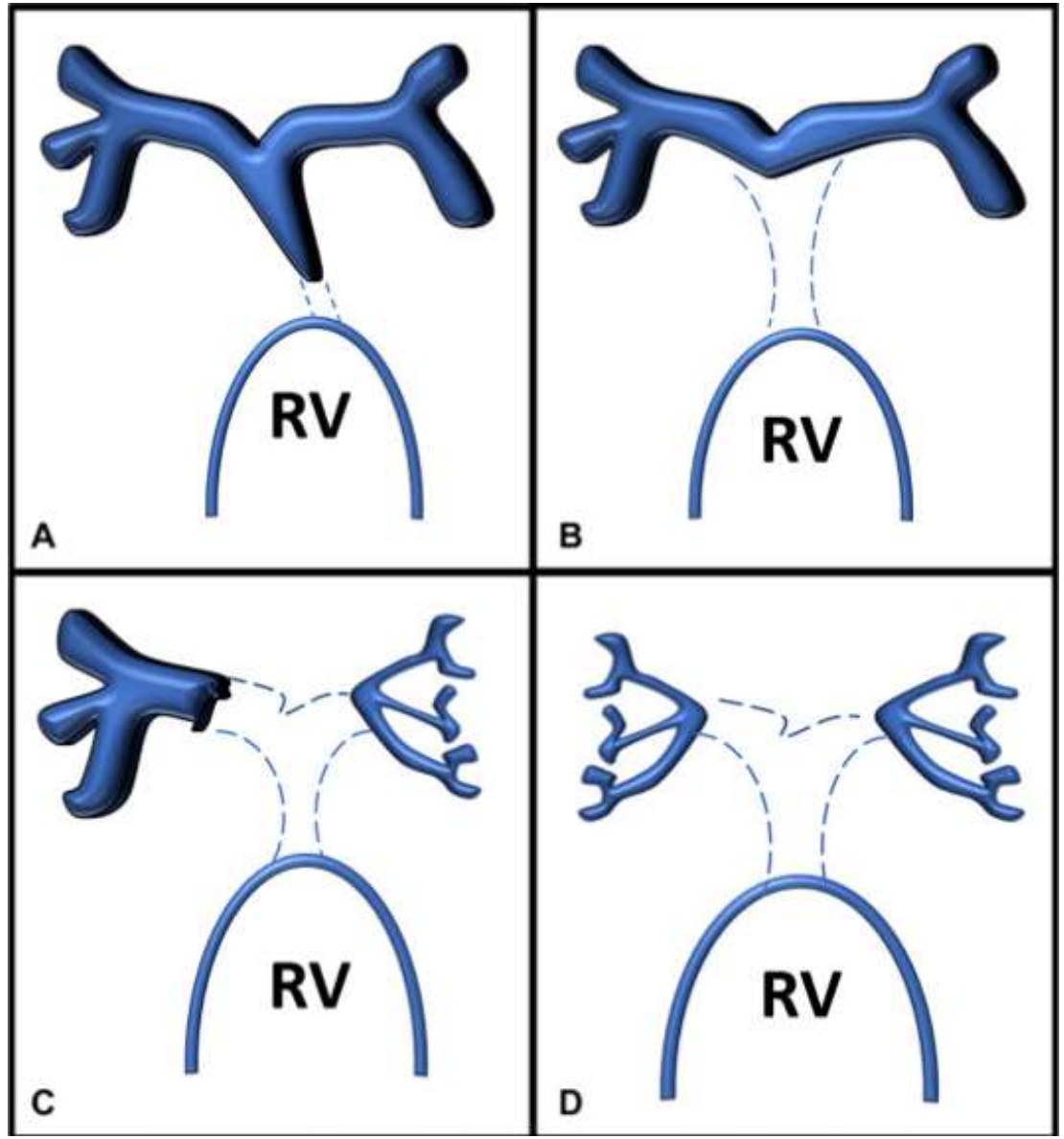


Subaortic ventricular septal defect

Somerville type II pulmonary atresia

Over-riding of aorta

Tetralogy of Fallot



Somerville classification of pulmonary arterial anatomy in pulmonary atresia with ventricular septal defect.

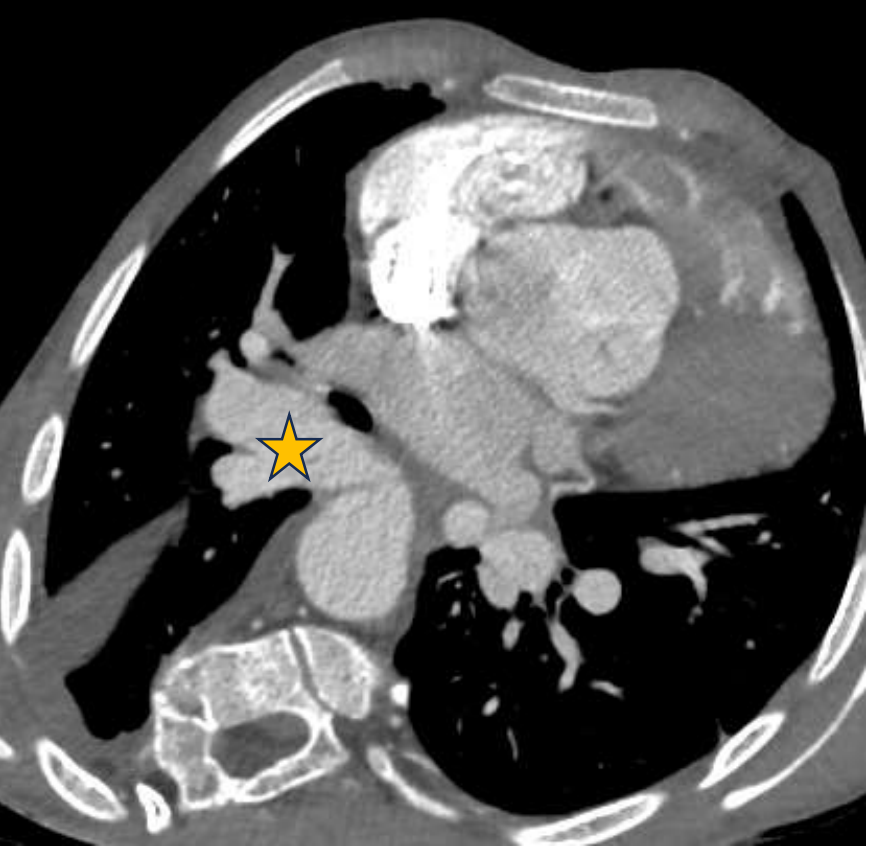


fig 1

Communication with Pulmonary Arteries-

- ✓ Communicating MAPCAs (i.e., nonessential MAPCAs) terminate by forming an anastomosis with distal pulmonary arteries. The lung segments may have a dual blood supply.
- ✓ Noncommunicating MAPCAs (i.e., essential MAPCAs) form the sole blood supply to the lung segment in the absence of a native pulmonary artery blood supply.

ig 2

❑**Few (2-3) tortuous major aortopulmonary collateral arteries as marked by yellow star in fig 1. and fig 2. (Type 2, communicating MAPCA)**

Type III - *Indirect branches from aorta via its major branches like subclavian artery, celiac artery, etc.*

Type I - *Branches from bronchial artery*

Bronchial artery

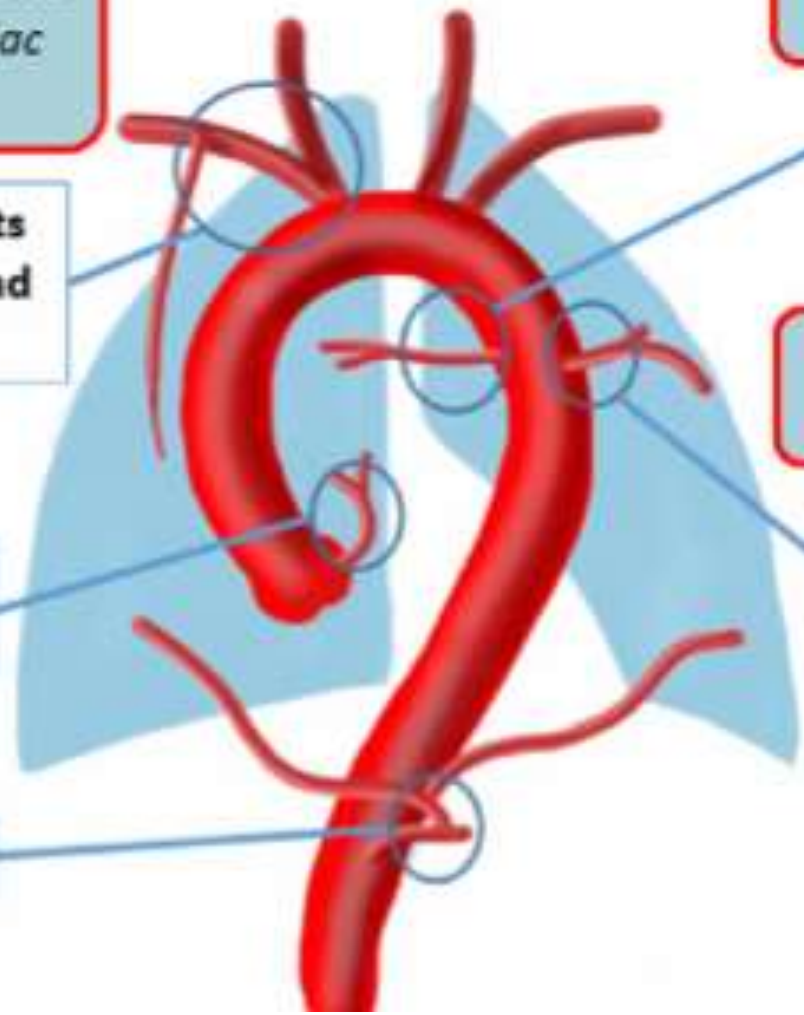
Subclavian Artery and its branches mainly IMA and vertebral artery.

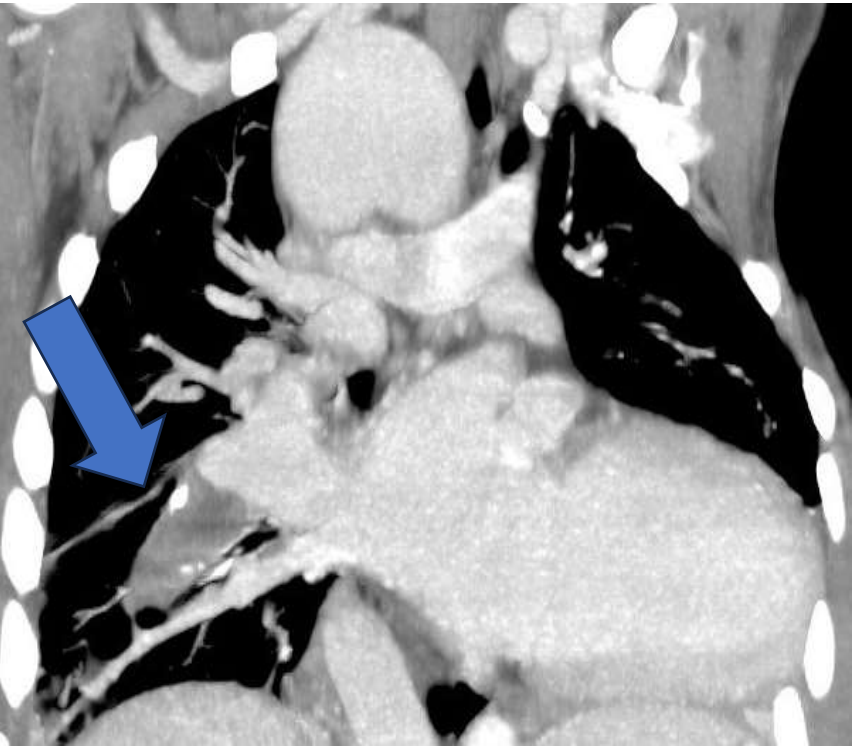
Type II - *Branches arising directly from Aorta*

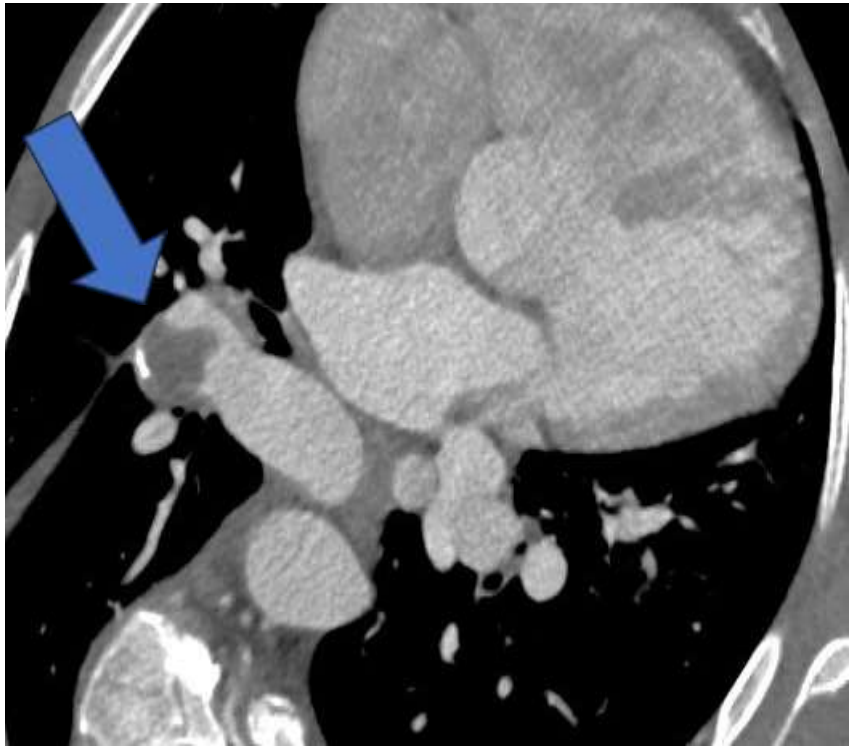
Coronary artery*(rarely)*

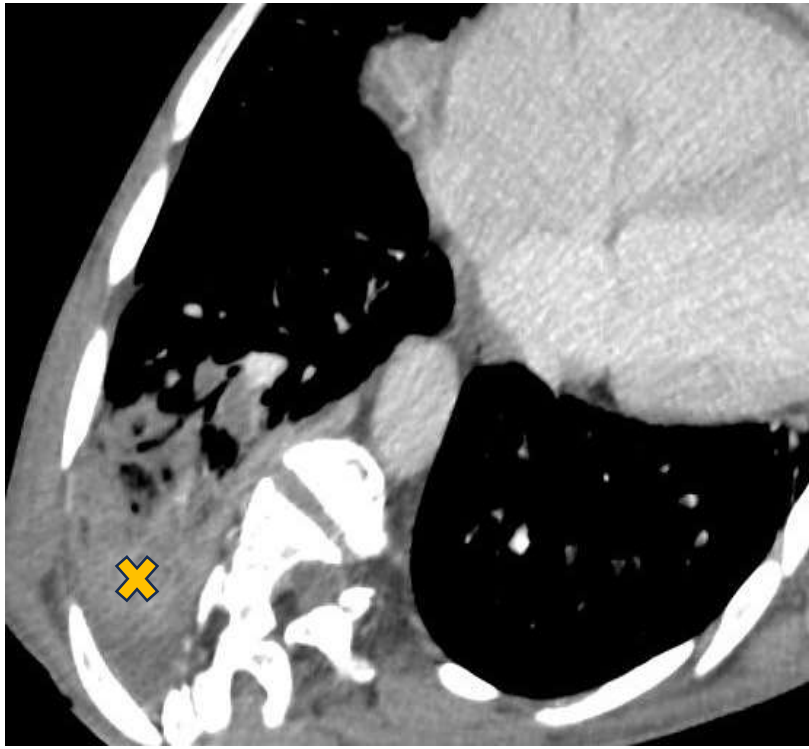
Aortic arch and Descending Thoracic Aorta- Mostly from D4-D6

Celiac Artery









- One of the collaterals is seen supplying the posterobasal segment of right lower lobe which shows complete contrast non opacification suggestive of thrombosis (as depicted by solid blue arrows)

- Segmental consolidation involving basal segments of right lower lobe with central cavitation within suggestive of pulmonary infarct. (as depicted by yellow cross sign)

Arterial Indices

Type	Formula	Remark
McGoon ratio	$\frac{Diameter\ LPA + Diameter\ RPA}{Diameter\ of\ DAo\ at\ diaphragm}$	Measure cranial-caudal axis before the origin of the first branch at hilum
Nakata index (mm^2/m^2)	$\frac{CSA\ of\ LPA + CSA\ of\ RPA}{BSA}$	Measure before the origin of the first branch at hilum
TNPAI (mm^2/m^2)	$\frac{CSA\ of\ LPA + CSA\ of\ RPA}{BSA}$	Indirectly using phase-contrast MRI by total pulmonary venous return from all four pulmonary veins

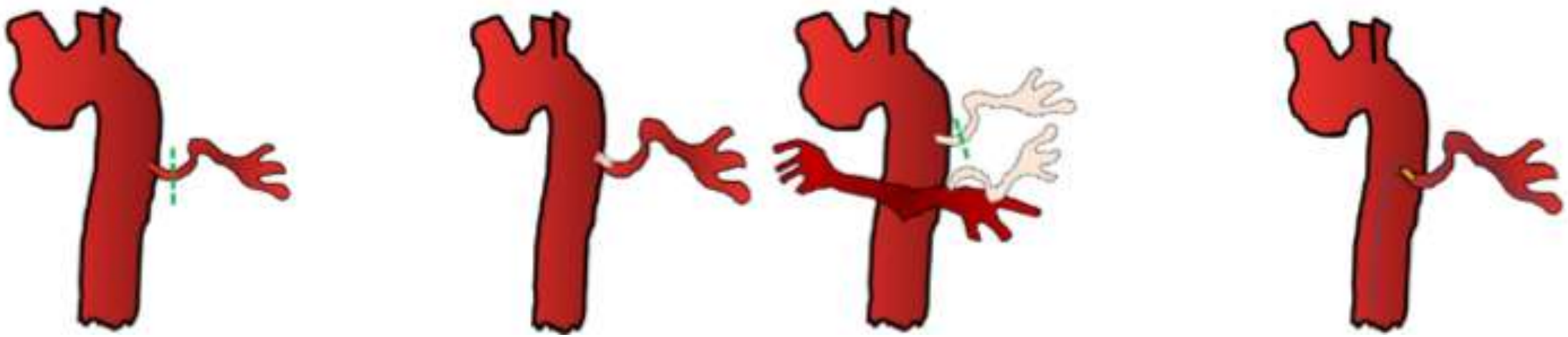
Note.—BSA = body surface area, CSA = cross-sectional area, DAo = descending aorta, LPA = left pulmonary artery, RPA = right pulmonary artery, TNPAI = total neopulmonary artery index.

In our case-

- ✓ **McGoon ratio: 1.1**
- ✓ **Nakata index – 236mm^2/m^2**

MANAGEMENT OPTIONS IN MAPCA

- Nonessential
  - Surgical
    - Ligation
  - Medical follow up
  - Endovascular
    - Coiling
- Essential
  - Surgical
    - Unifocalization
  - Medical follow up
  - Endovascular
    - Balloon dilation/stenting



Summary

- The presence of MAPCAs is a major determining factor in the prognosis of various congenital heart diseases involving pulmonary outflow abnormalities.
- Role of a cardiac radiologist is in reporting critical components regarding the collateral vessels and underlying cardiac structural disease.
- With endovascular management offering excellent results, and owing to the simplicity of the procedure compared with open surgical ligation, it is now considered the standard of care in patients requiring occlusion of the collaterals.
- **The role of the radiologist is in identifying and describing in detail the segmental arterial supply of both the lungs so that the surgeon can decide which segments would need unifocalization**.

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THANK YOU