



Weill Cornell Medicine

Hospital Medicine Point of Care Ultrasound
(HM POCUS) Program

Is there more to this picture?

Jina Bai

&

Todd Cutler

2019

A case from the PA service

A 49 year old man with active injection drug use is admitted with two weeks of lower back pain and weight loss

He has no fevers or constitutional symptoms

MRI of the spine suggest lumbar osteomyelitis

Admission vitals

110/69, 79, RR: 18, SpO₂: 95%, Temp: 36.9,

Admission Physical Exam

Pleasant, comfortable, in no distress,

No lymphadenopathy

RRR, normal s1/s2, no murmurs

No TTP over spine or paraspinal muscles

Warm, no edema, no clubbing or cyanosis

Labs:

WBC: 5.4 / Hb: 11.7 (MCV: 89.0) / Hct:
34.8 / Plt: 337

Electrolytes within normal limits

LFT: unremarkable

Coags: normal

HIV negative

POCUS

02/22/19 07:55:21AM ADM JB, 022219-075004AM

GE
Le

3Sc Adult MI 1.2 TIs 0.1

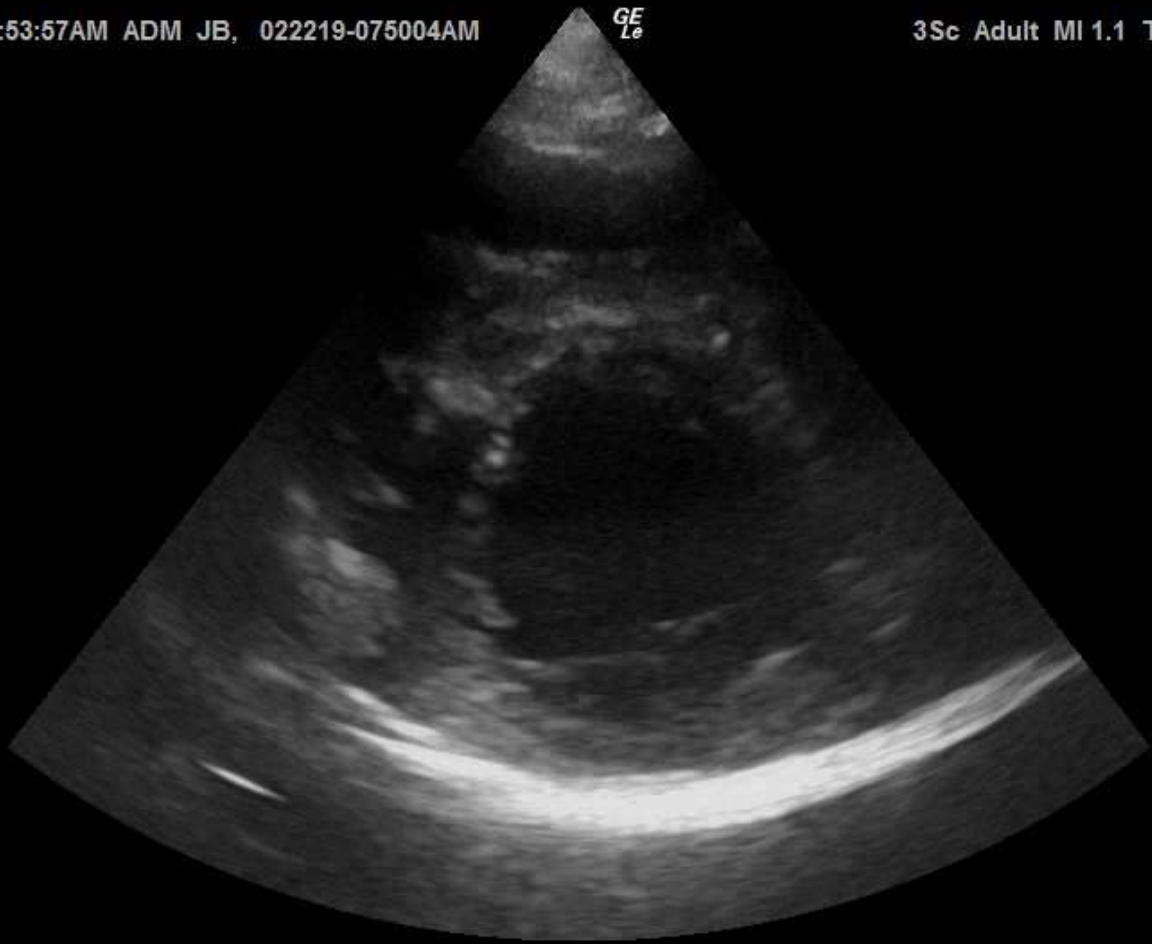


0
5M
10
15

02/22/19 08:53:57AM ADM JB, 022219-075004AM

GE
L_e

3Sc Adult MI 1.1 TIs 0.1



5

10

02/22/19 09:01:53AM ADM JB, 022219-075004AM

GE
L₂

3Sc Adult MI 1.2 TIs 0.1

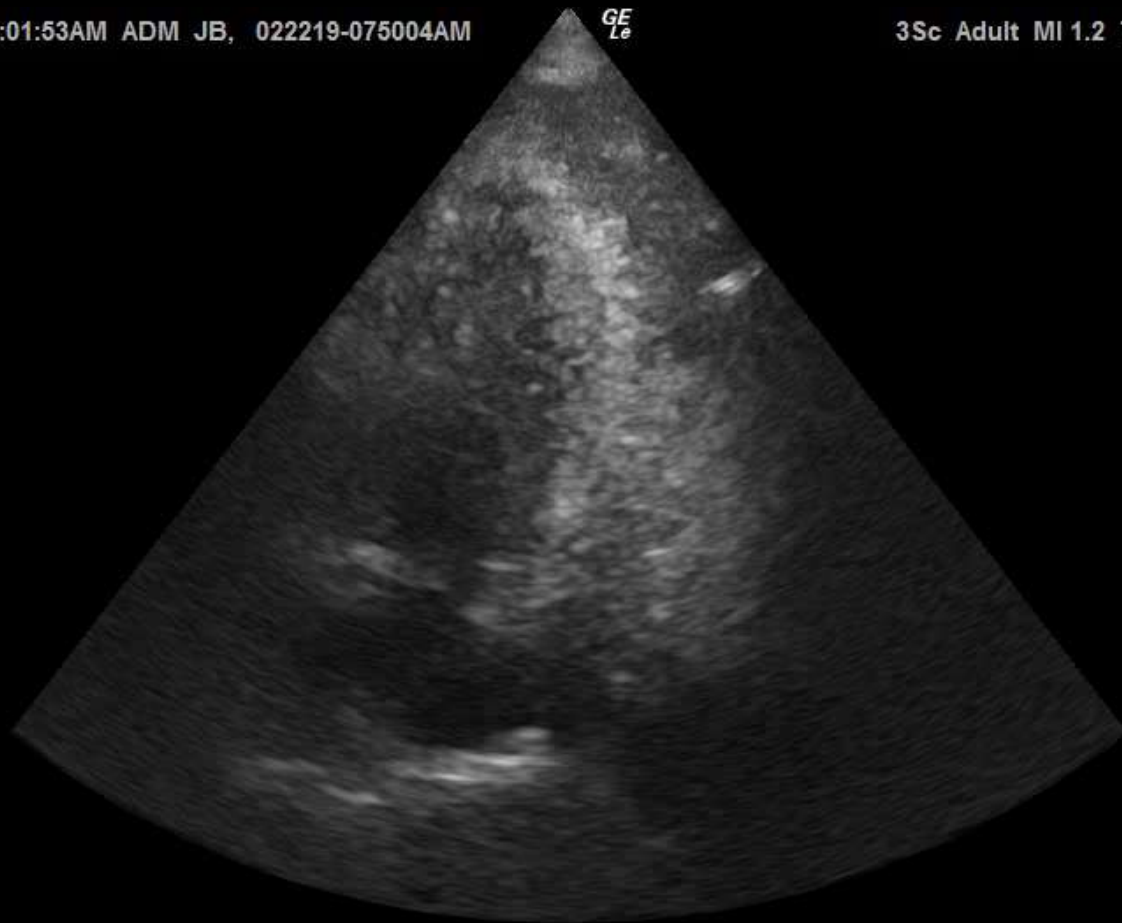
0-

5

10

15

20



02/22/19 08:58:45AM ADM JB, 022219-075004AM

GE
Le

3Sc Adult MI 1.2 TIs 0.1



0
5
10
15

02/22/19 07:56:55AM ADM JB, 022219-075004AM

GE
L6

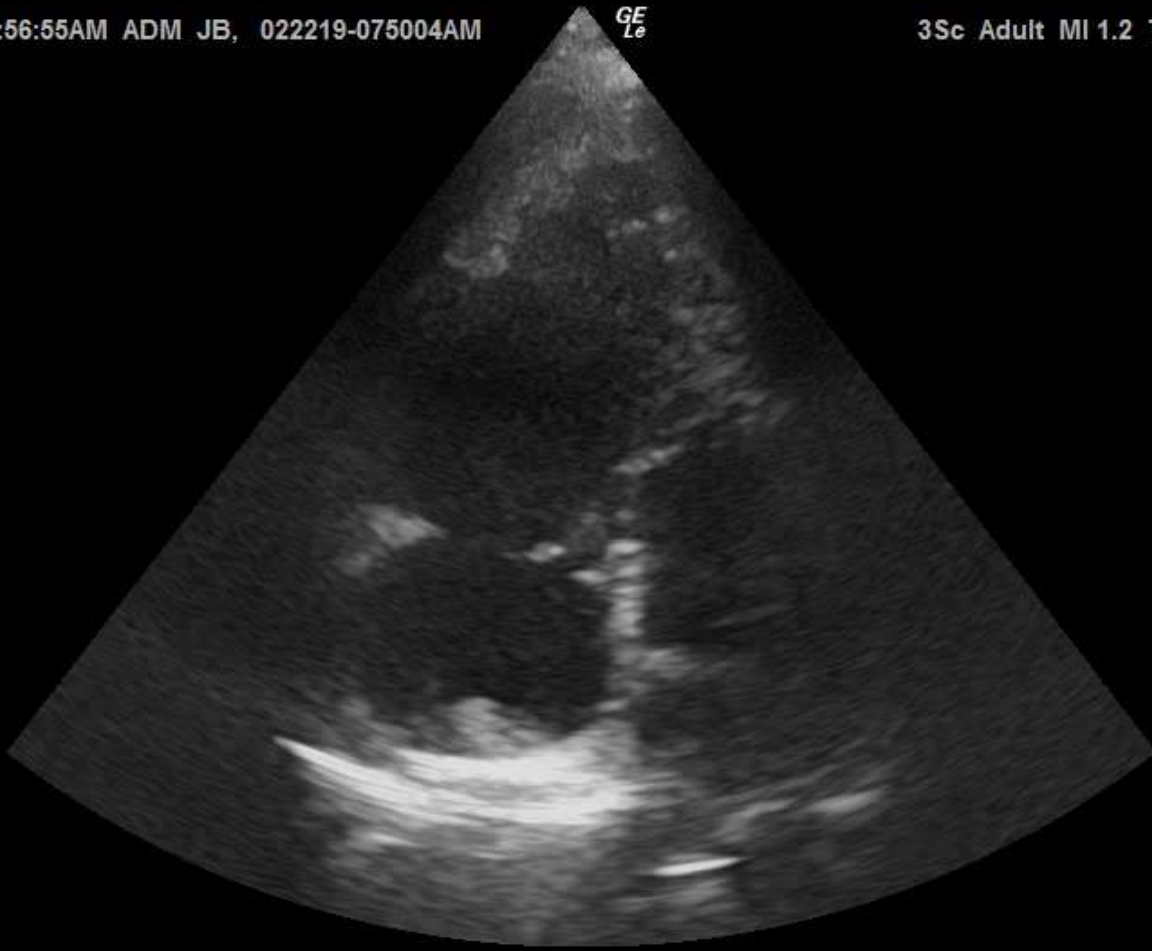
3Sc Adult MI 1.2 TIs 0.1

0-

5M

10-

15-



02/22/19 07:51:47AM ADM JB, 022219-075004AM

GE
L_e

3Sc Adult MI 1.2 TIs 0.2

U-



H

10-

H

20-

02/22/19 09:17:18AM ADM JB, 022219-075004AM

GE
Le

3Sc Adult MI 1.1 TIs 0.1

0-

5

10-



02/22/19 09:15:03AM ADM JB, 022219-075004AM

GE
Le

3Sc Adult MI 1.2 TIs 0.1

0-

5M

10-

M

15-



02/22/19 09:20:05AM ADM JB, 022219-075004AM

GE
Le

3Sc Adult MI 1.1 TIs 0.1

U-



5

10

15

I AM



PANICKING

Official TTE

Interpretation Summary

Normal left ventricular size and function.

Normal right ventricular size and function.

Normal valvular function by Doppler.

Normal left ventricular diastolic relaxation.

Pulmonary artery systolic pressure cannot be determined.

No mention of anything weird in the right atrium

So what now?

Call echo lab: did you scan wrong patient? Did I scan wrong patient?

Call the echo attending who read the study: do you see what I see?

Phone POCUS gurus

Phone cardiology friends

DON'T PANIC!



IT'S UNDER CONTROL!

KULONLINE.SE

What can you see in the Right Atrium?

Most anatomic variants in the right atrium are remnants of the right sinus venosus valve

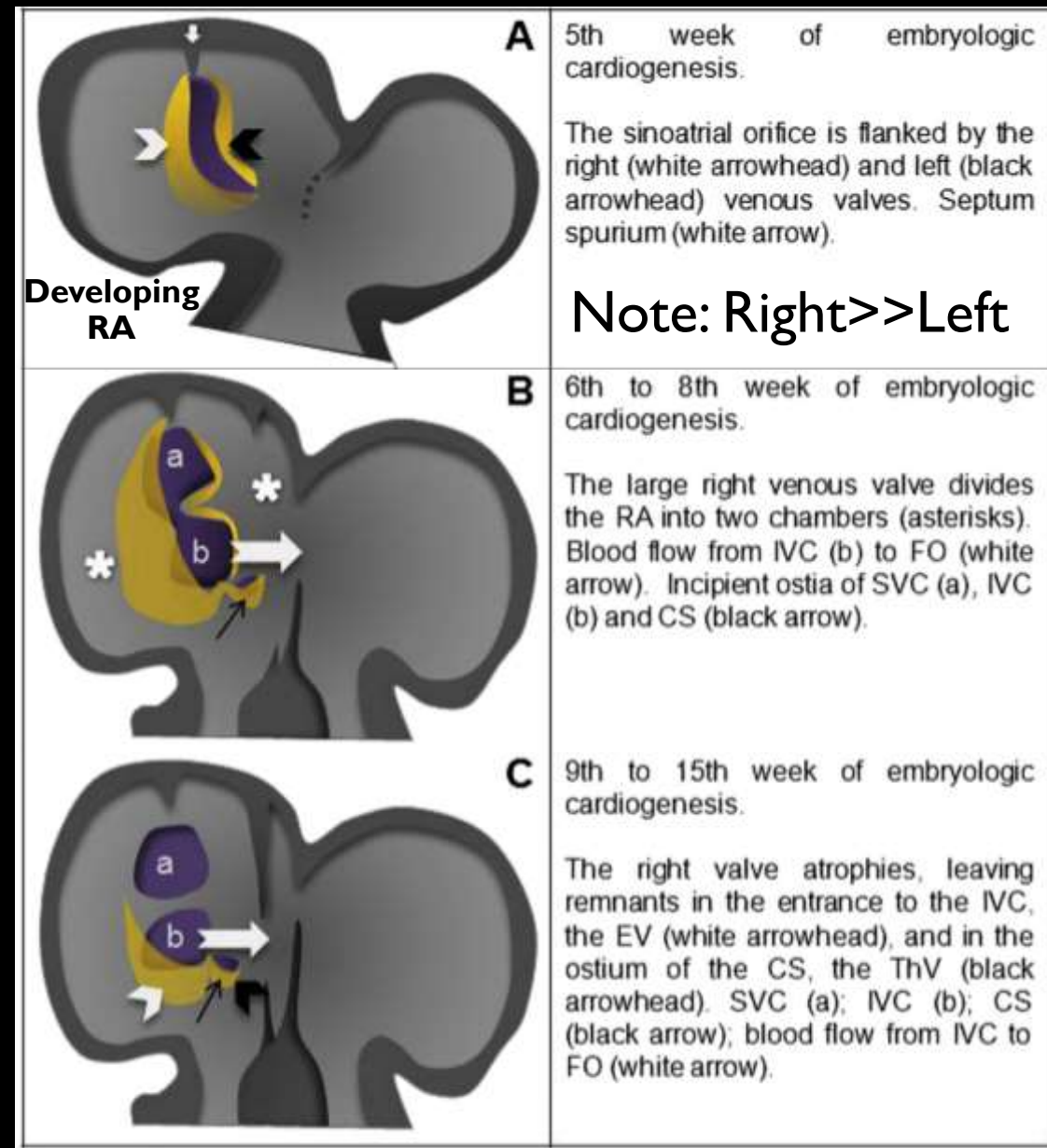
What is the right sinus venosus valve?

Time for some embryology...

In the fifth week of cardiogenesis, the umbilical and vitelline (yolk sac) veins drain into the primitive right atrium through the sinus venosus and its right and left venous valves.

Between week six and eight, the sinus venosus splits into the primitive SVC and IVC. The right venous valve extends from the lateral margin of the SVC to the IVC and coronary sinus, and it directs oxygenated blood from the IVC towards the foramen ovale.

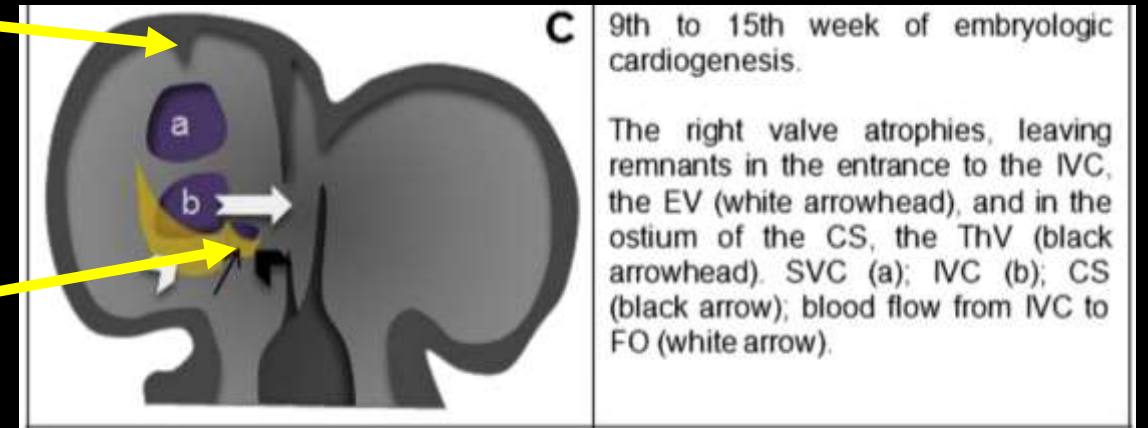
Between week nine and 15 the left valve fuses with the developing septum. The right valve atrophies with the cranial portion forming the crista terminalis. The caudal portion fuses with the IVC orifice and coronary sinus.



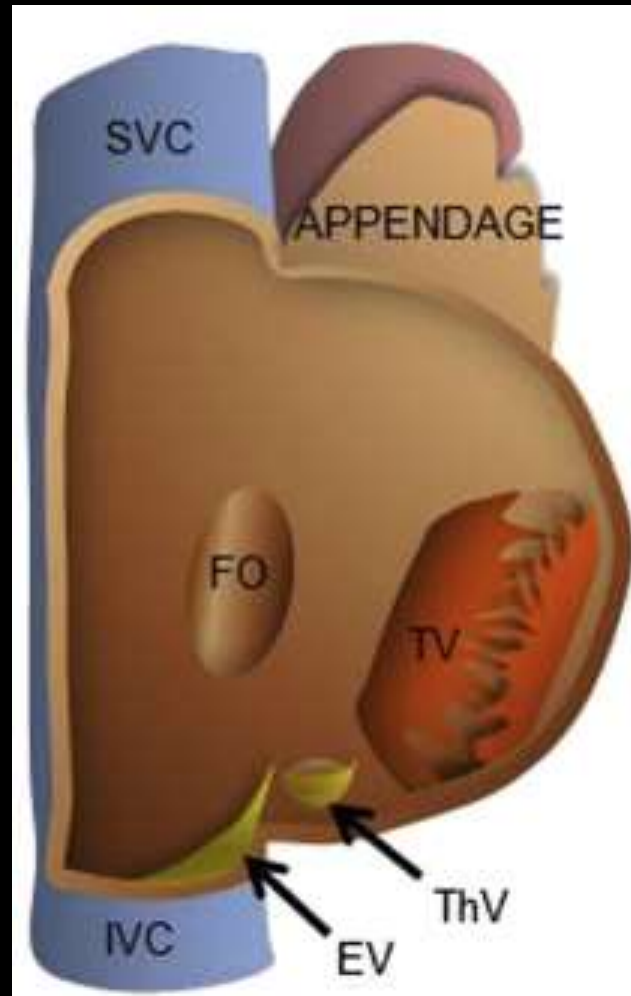
So the remnants of the right venous valve are:

Superiorly/cranially: the crista terminalis

Inferiorly: the Eustachian Valve, the coronary sinus valve (Thebesian valve) and Chiari network



So what can be seen in the right atrium?



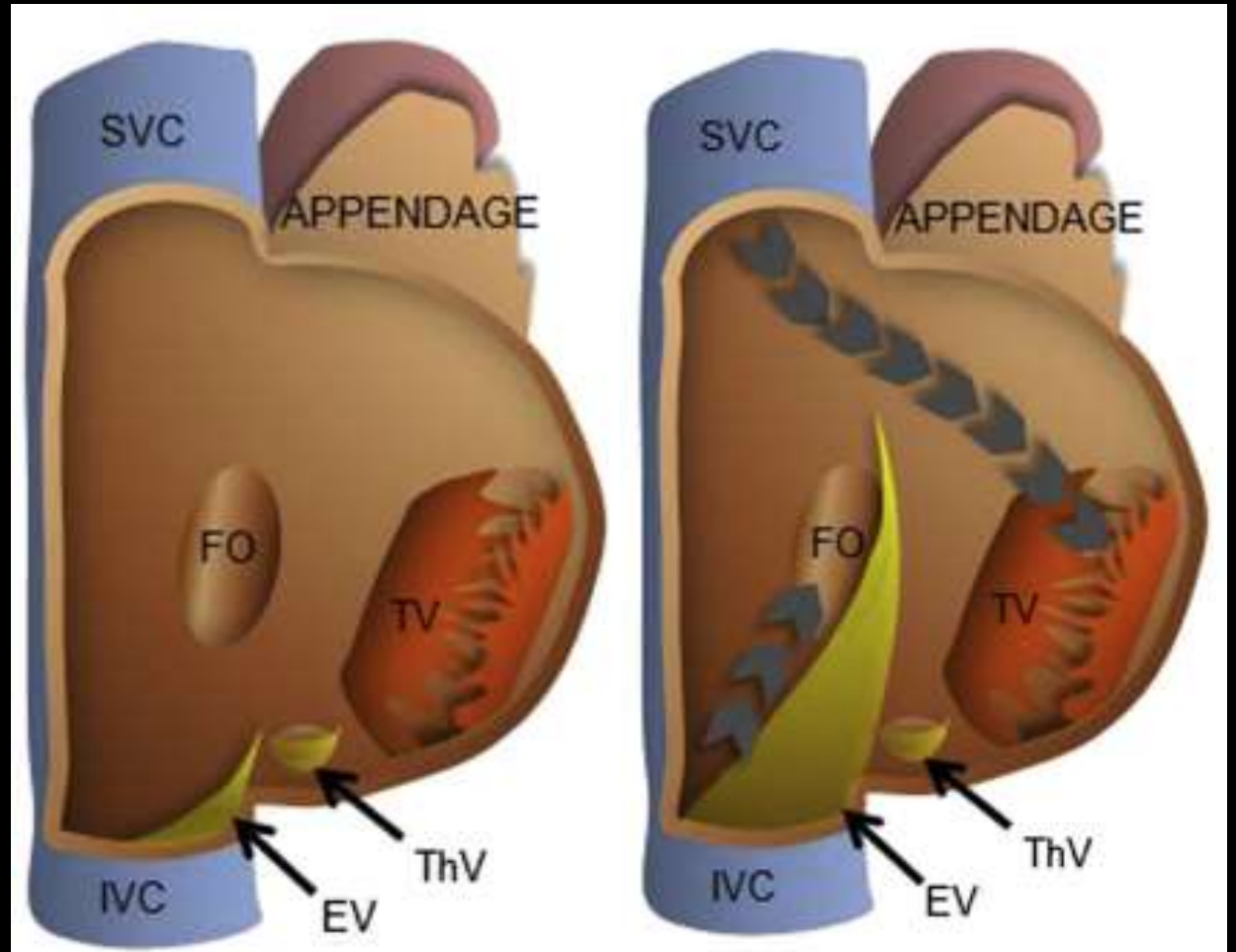
Eustachian valve

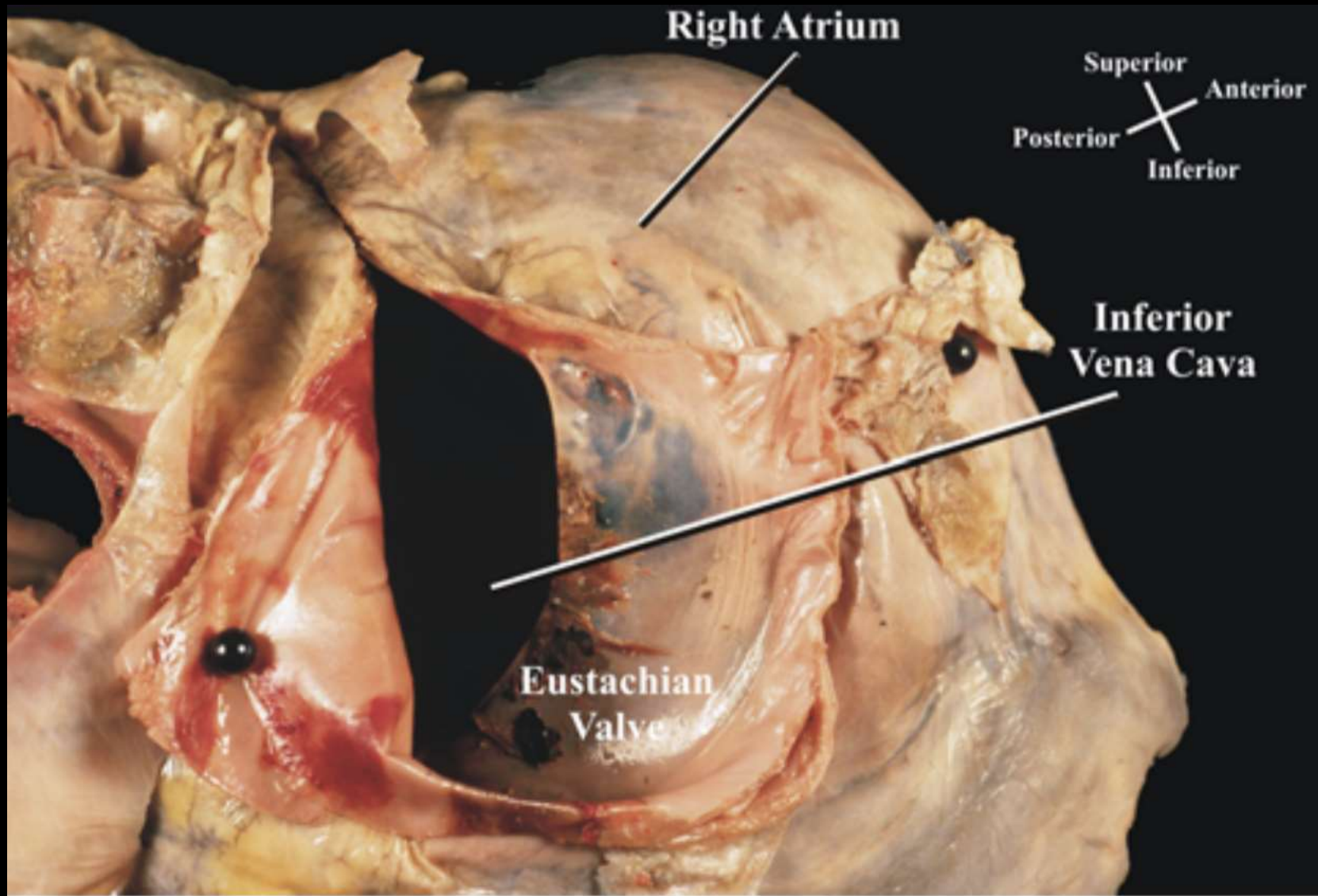
Remnant of embryonic valve of IVC

Not a true valve. That is, it does not function to prevent regurgitation of blood

Usually appears as “crescent-like fold” at posterior margin of IVC

Best viewed in subcostal/IVC view (or RV inflow view, or TEE): can visualize Eustachian valve and IVC in the same imaging plane





Chiari's network: review of the literature

Surg Radiol Anat (2010) 32:895–901

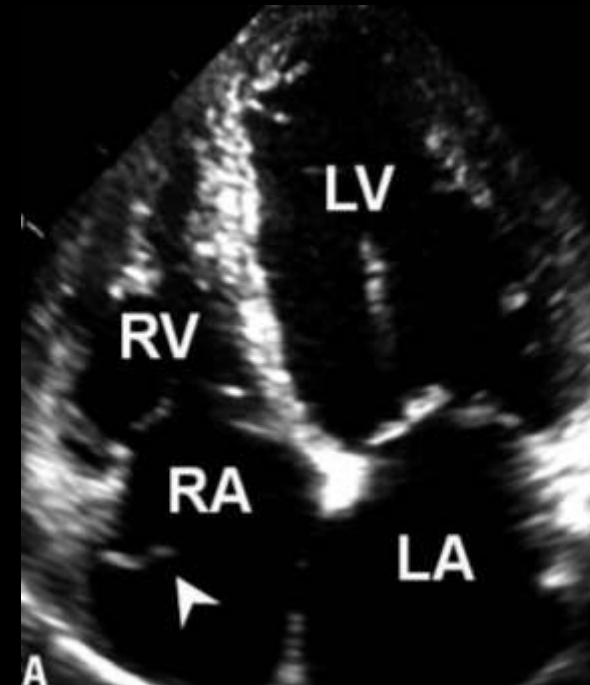
Eustachian valve

Prevalence depends on modality (for example, US versus autopsy) but about 4% on US

Usually benign although there is an association with patent foramen ovale

Can be confused with RA tumors, thrombi or vegetation

Cases of endocarditis and thrombus attaching to Eustachian valve has been reported

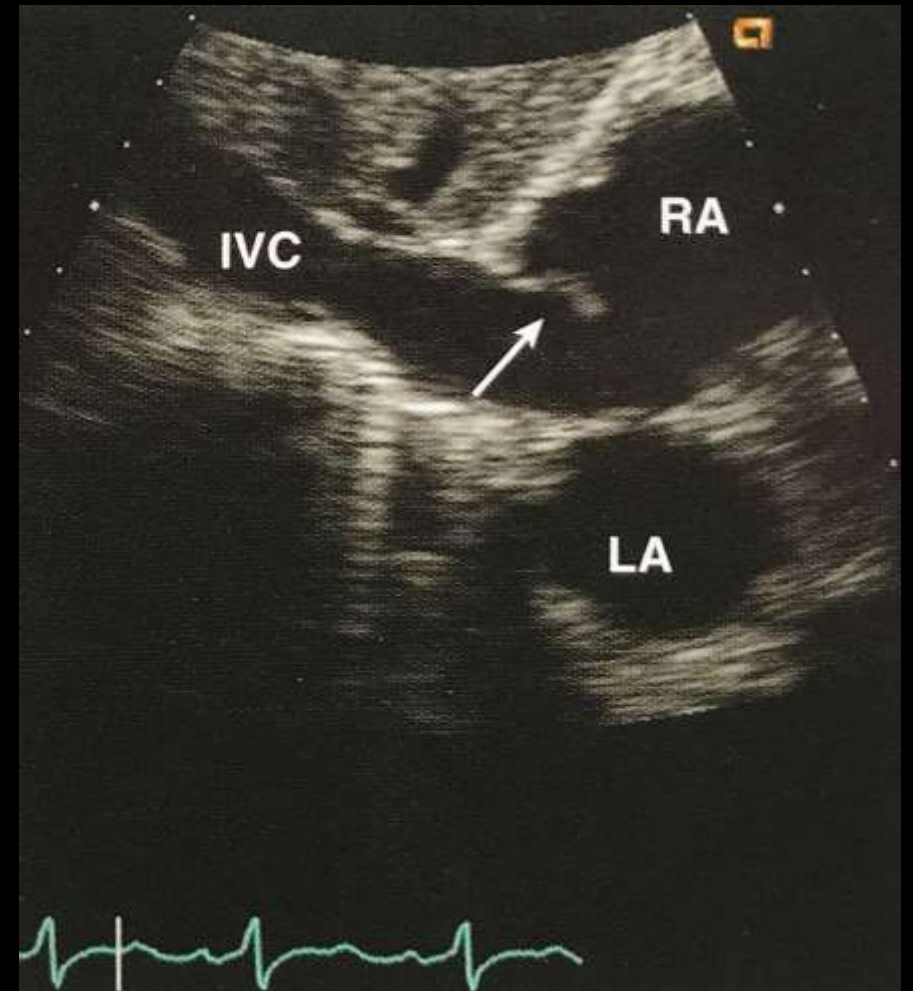


Eustachian Valve Pitfalls

The valve itself can appear quite prominent especially in the apical four chamber view.

This appearance can resemble an intra-atrial mass.

A subcostal view showing the IVC can demonstrate the origin of the valve more clearly.



It's not that rare!

04/05/19 09:45:19AM ADM

GE
L_e

3Sc Adult MI 1.2 TIs 0.4

0-

5-

10-

15-



-

-

-

-

-

-

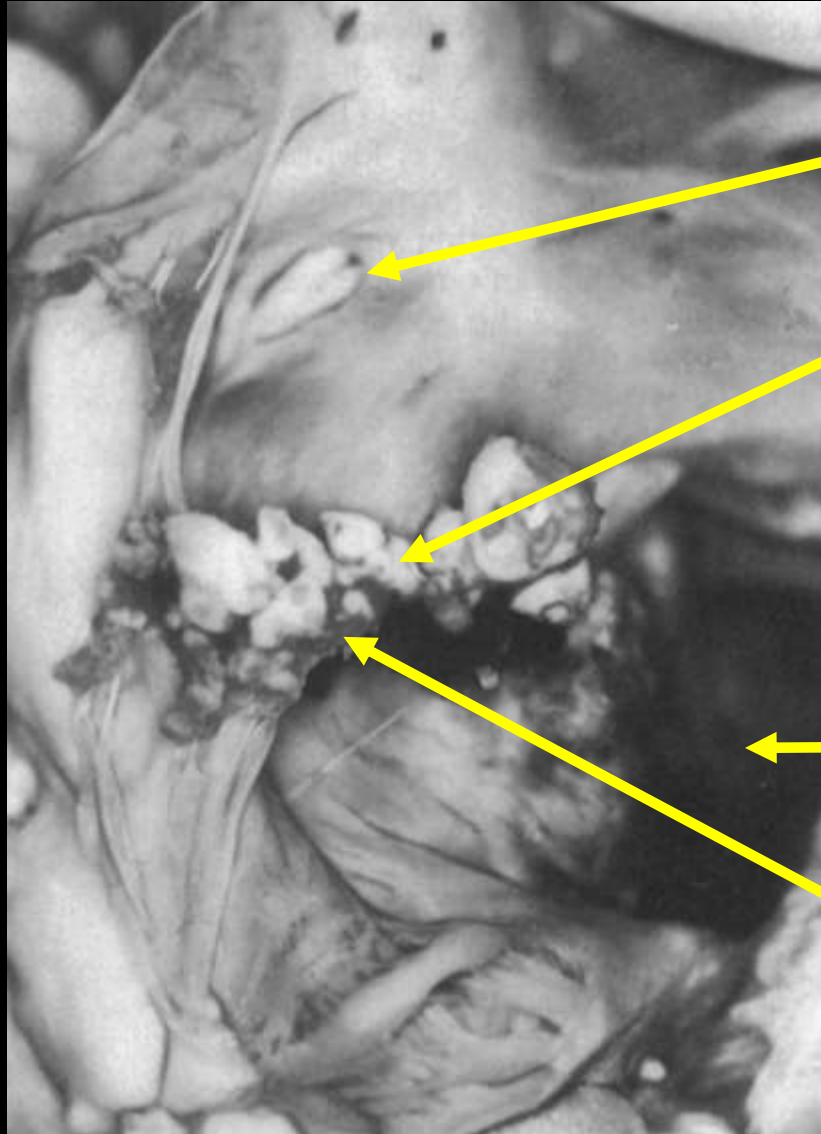
-

-

-

Infective endocarditis affecting the eustachian valve

Br Heart 1986;56:561-2



Fossa ovalis

Vegetations

Tricuspid Orifice

Eustachian Valve

The eustachian valve, covered with large vegetations, crosses the right atrium with its chordae tendineae extending above and below. The dark area, bottom right, is the orifice of the tricuspid valve; the oval fossa is evident above the eustachian valve.

Note: Eustachian valve vegetations were not seen on echocardiogram in this patient

**Eustachian valve endocarditis:
Rare case reports and review of literature**

Gaurav Alreja¹, Amir Lotfi^{1,2}

33 year old woman with IV drug use

CXR

TTE: mobile TV vegetation

TEE: 6cm echogenic mass attached to the EV

Bcx: MRSA

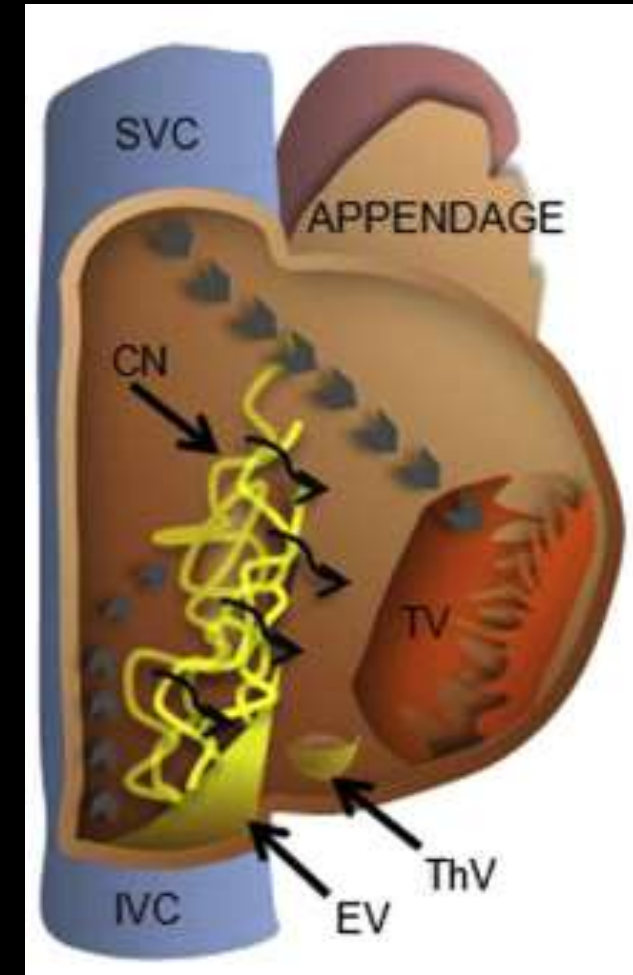
Chiari network

Prominent fibrous extensions that originate from the Eustachian valve

Can extend to the crista terminalis, intraatrial septum and coronary sinus valve (aka Thebesian Valve)

Can appear “free floating” and wave with blood flow

Small, rapidly moving echogenic strands within the RA is suggestive of a Chiari network



Differential Diagnosis and Clinical Implications of Remnants of the Right Valve of the Sinus Venosus. *Journal of the American Society of Echocardiography*, 29(3), 183–194.

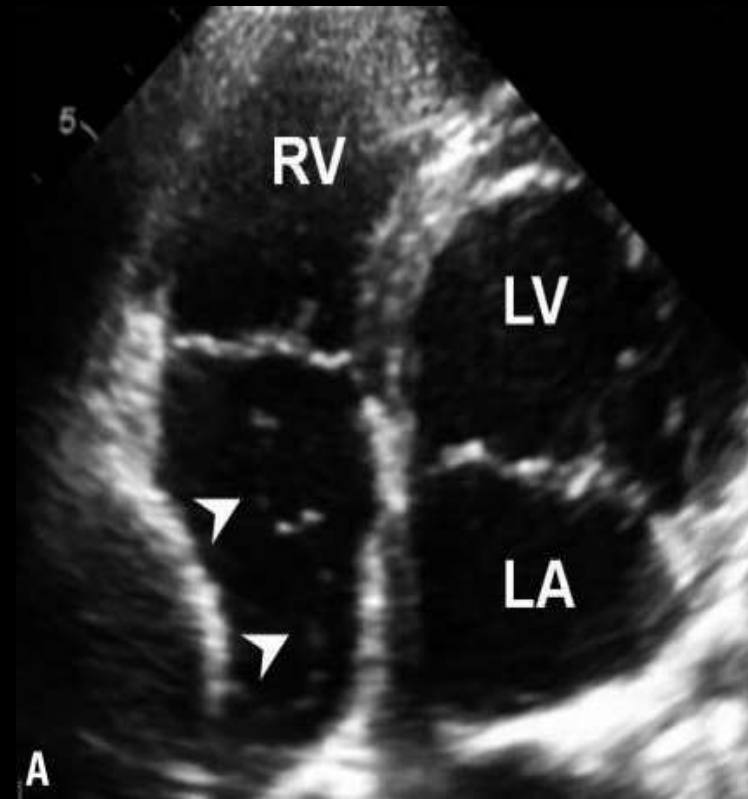
Textbook of Clinical Echocardiography. Catherine M. Otto. Sixth Ed.

Chiari network

Common (2%-15%) depending on the imaging modality used

Believed to be associated with atrial septal aneurysms or patent foramen ovale

Inherently benign and rarely causes problems...



02/22/19 09:17:18AM ADM JB, 022219-075004AM

GE
L_o

3Sc Adult MI 1.1 TIs 0.1

0-



5-

10-

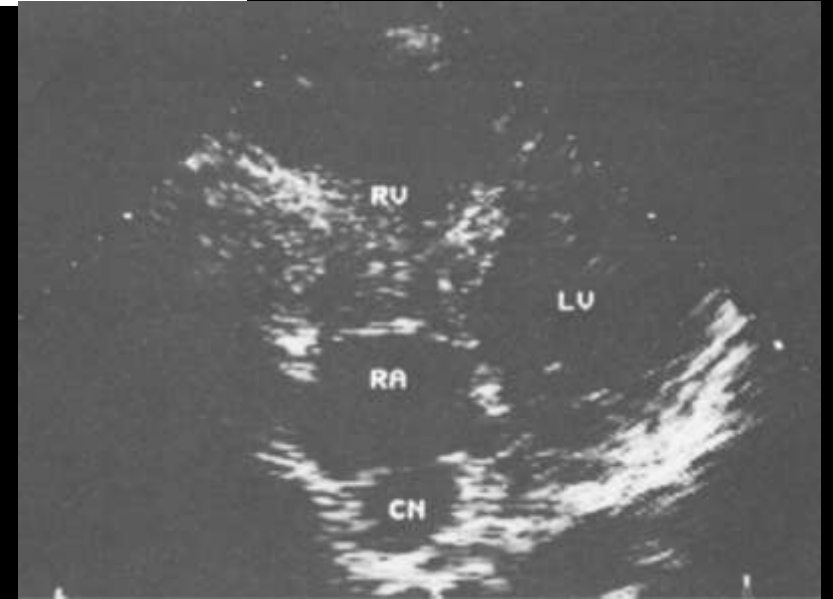
15-

Chiari Network Entrapment of Thromboemboli: Congenital Inferior Vena Cava Filter

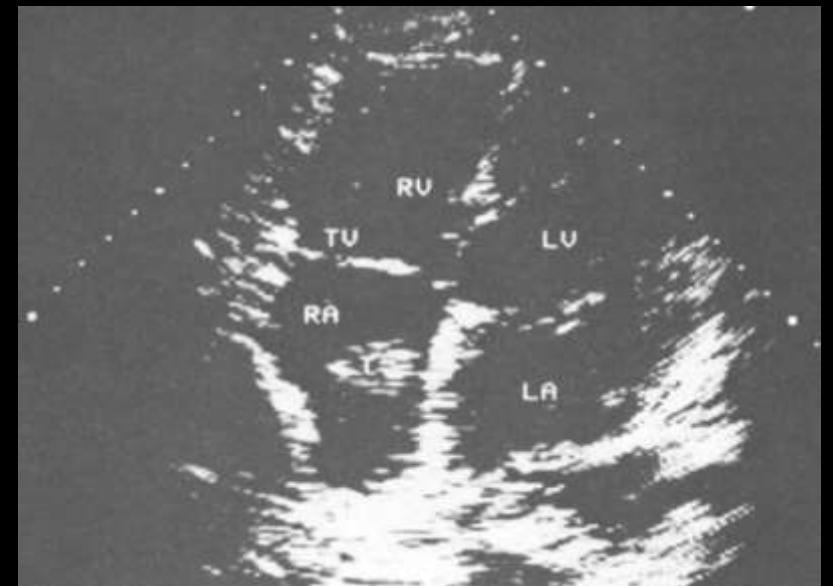
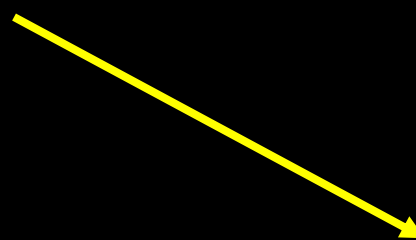
Ann Thorac Surg
1990;49:317-8

69 year old man admitted w/ SOB

TTE



Repeat TTE 3 weeks later



Chiari Network Entrapment of Thromboemboli: Congenital Inferior Vena Cava Filter

Ann Thorac Surg
1990;49:317-8

Findings were concerning for a thrombus and the patient was started on heparin.

AVQ scan revealed a high probability of pulmonary embolism

Because of the size and mobility of the mass the patient was taken for cardiopulmonary bypass.

A 3x2x2cm organized thrombus was found enmeshed in the “lacelike remnants of the Eustachian valve (Chiari network)”

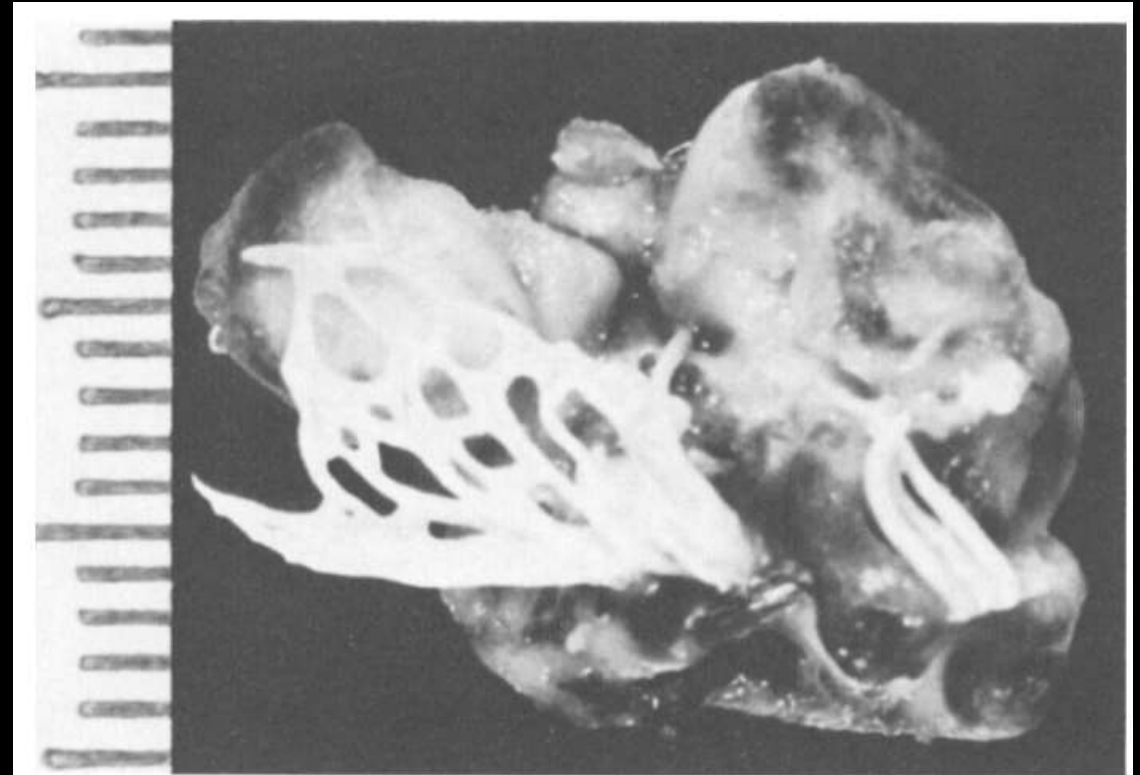


Fig 2. The gross surgical specimen revealing the organized thrombus enmeshed in the Chiari network. One centimeter is equal to the distance between five linear marks on the scale at the left-hand border.

Chiari Network Entrapment of Thromboemboli: Congenital Inferior Vena Cava Filter

Ann Thorac Surg
1990;49:317-8

The patient was subsequently found to have a left-leg
deep vein thrombosis

The authors speculated that the Chiari network
served as a literal IVC filter and “most likely
prevented massive pulmonary embolism.”

04/05/19 09:38:45AM ADM

GE
L_o

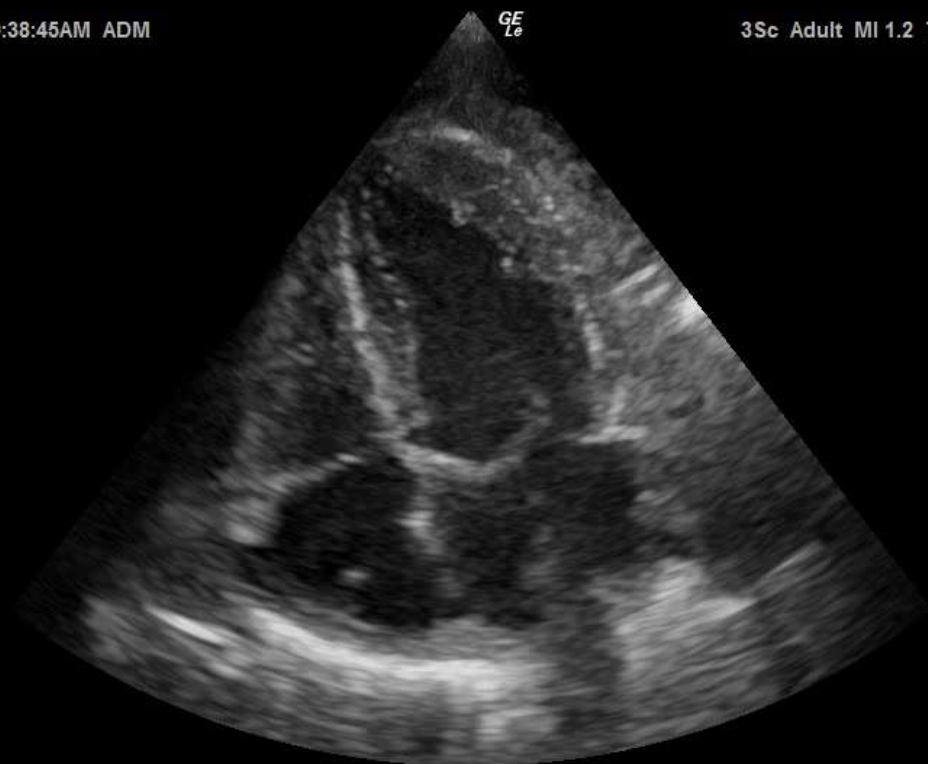
3Sc Adult MI 1.2 TIs 0.4

0-

5-

10-

15-



M

THE CHIARI NETWORK AND THE VALVE OF THE INFERIOR
VENA CAVA

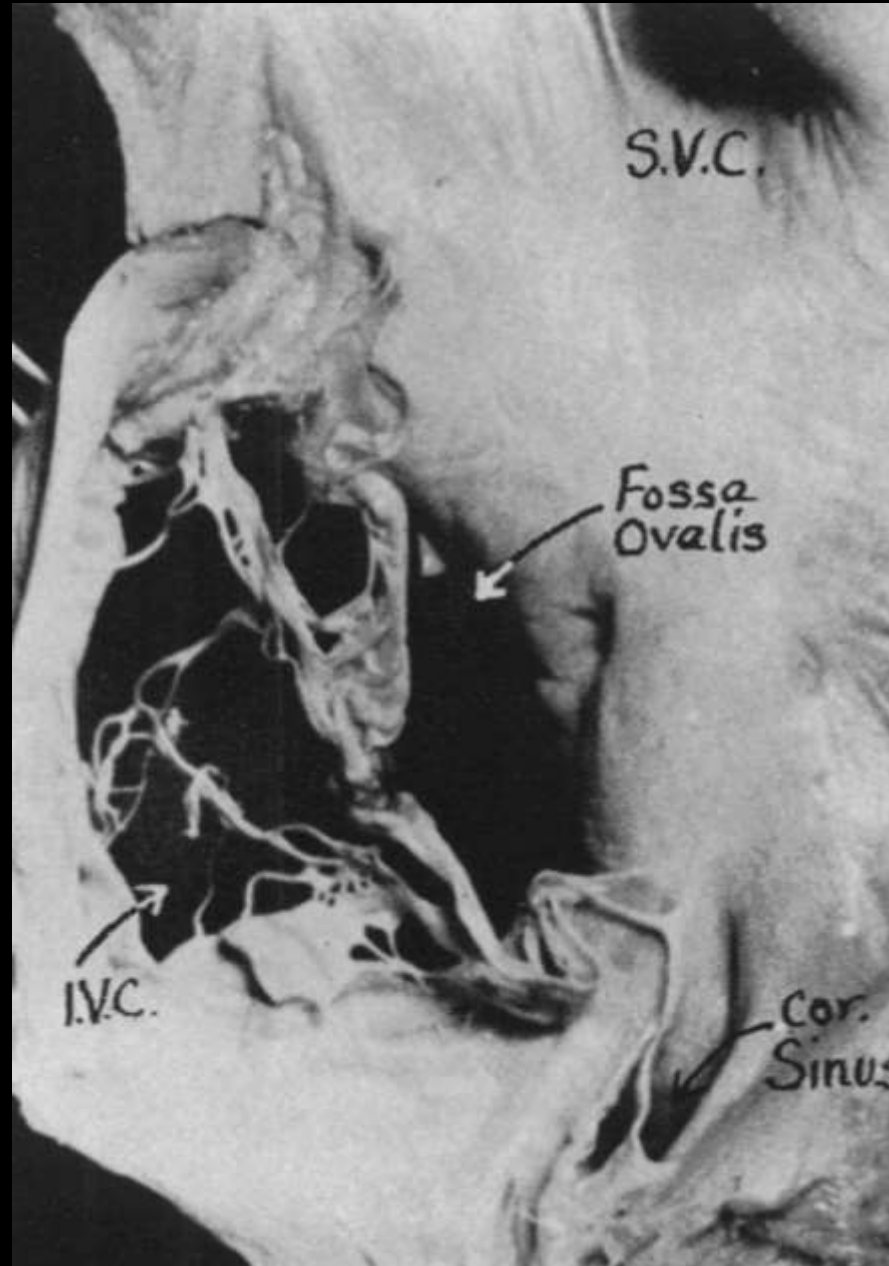
BY

ELINOR D. U. POWELL AND JOAN M. MULLANEY

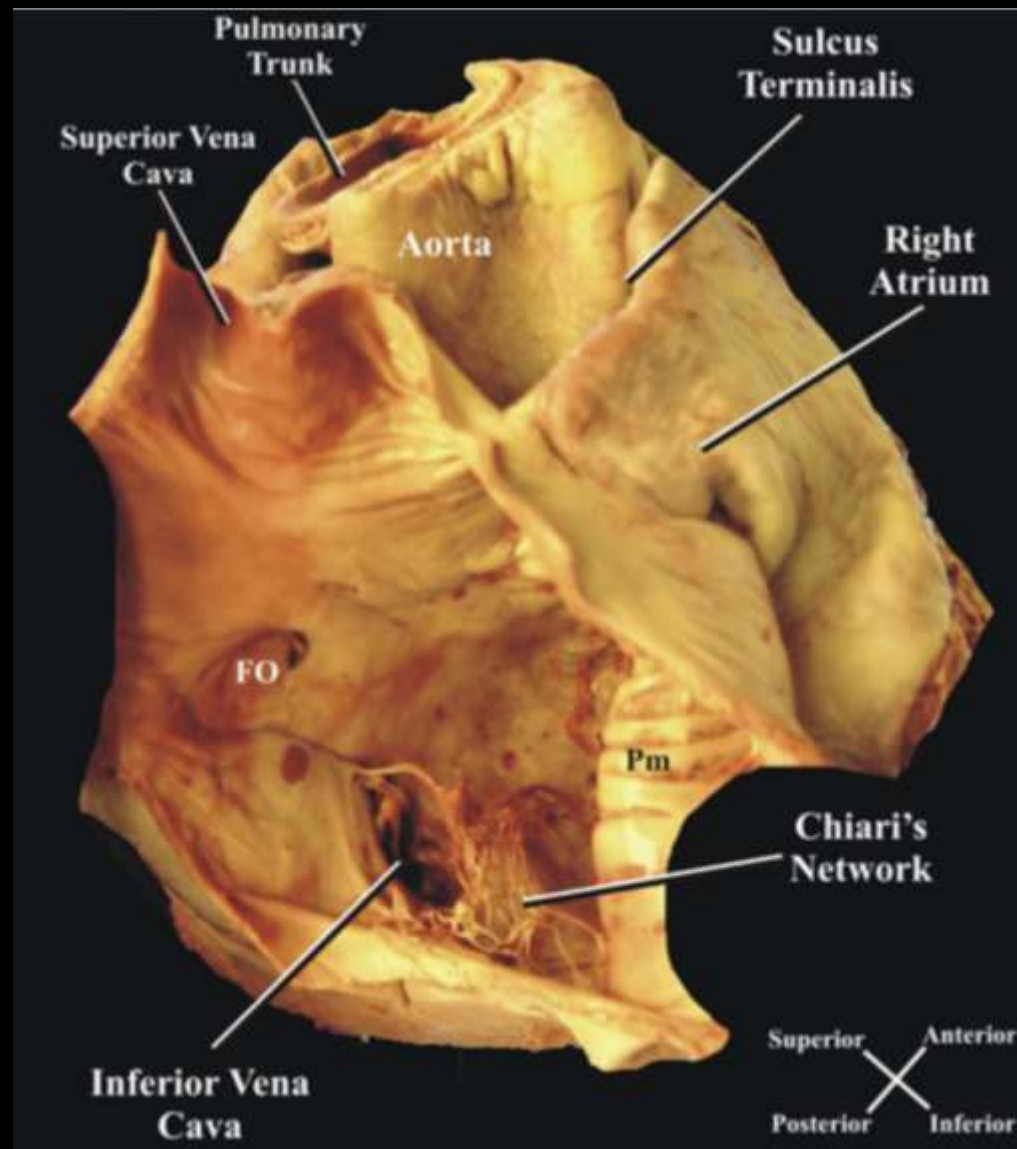
From the Departments of Medicine and Pathology, Trinity College, Dublin

Received January 27, 1960

[Br Heart J.](#) 1960 Sep; 22(4): 579-584.



Chiari
Network at
the level of
the inferior
vena cava.



Chiari's network: review of the literature

Surg Radiol Anat (2010) 32:895–901

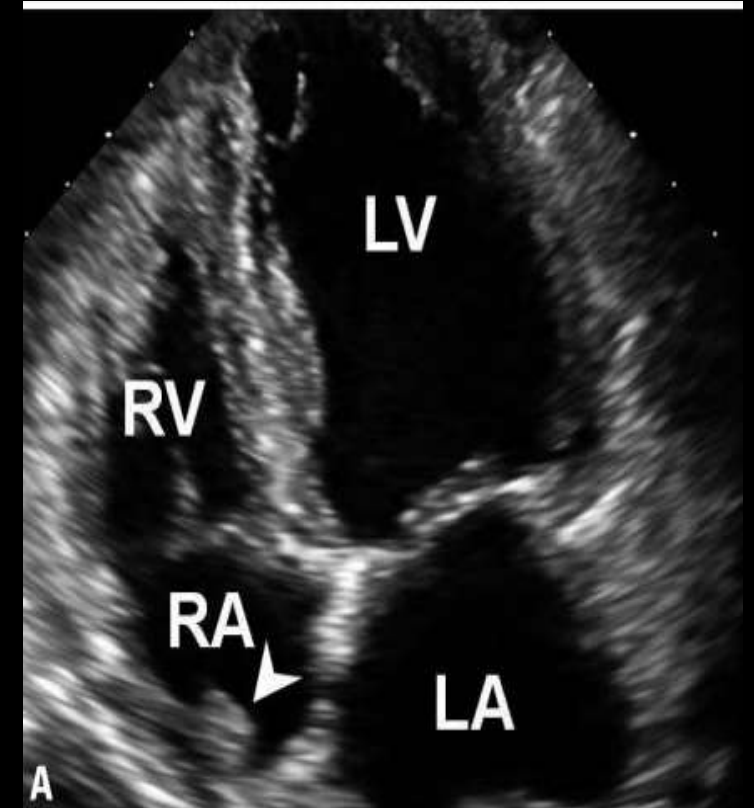
Crista Terminalis

Fibromuscular ridge on the internal wall of RA

Extends from the SVC to IVC along the lateral RA wall

Appears as “nodular mass” on the wall of myocardium

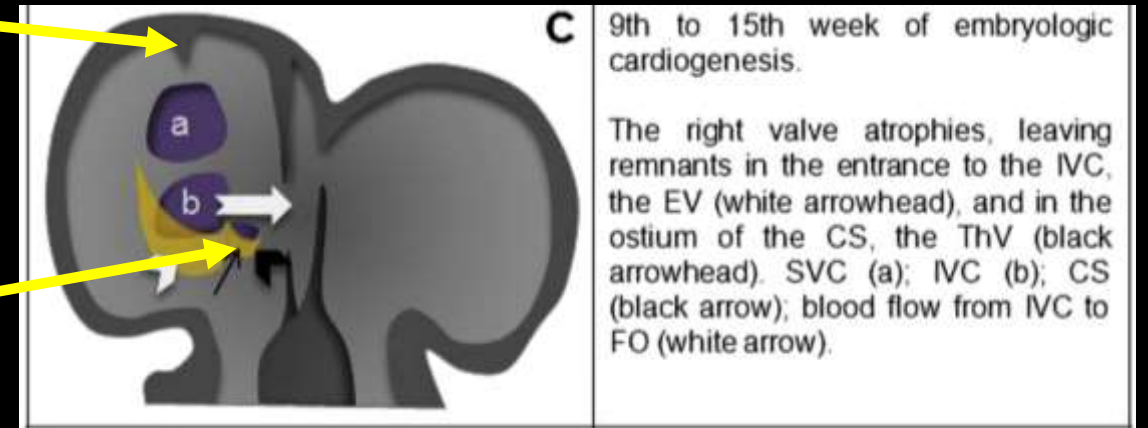
Clinical implication: can look like mass-like tumor



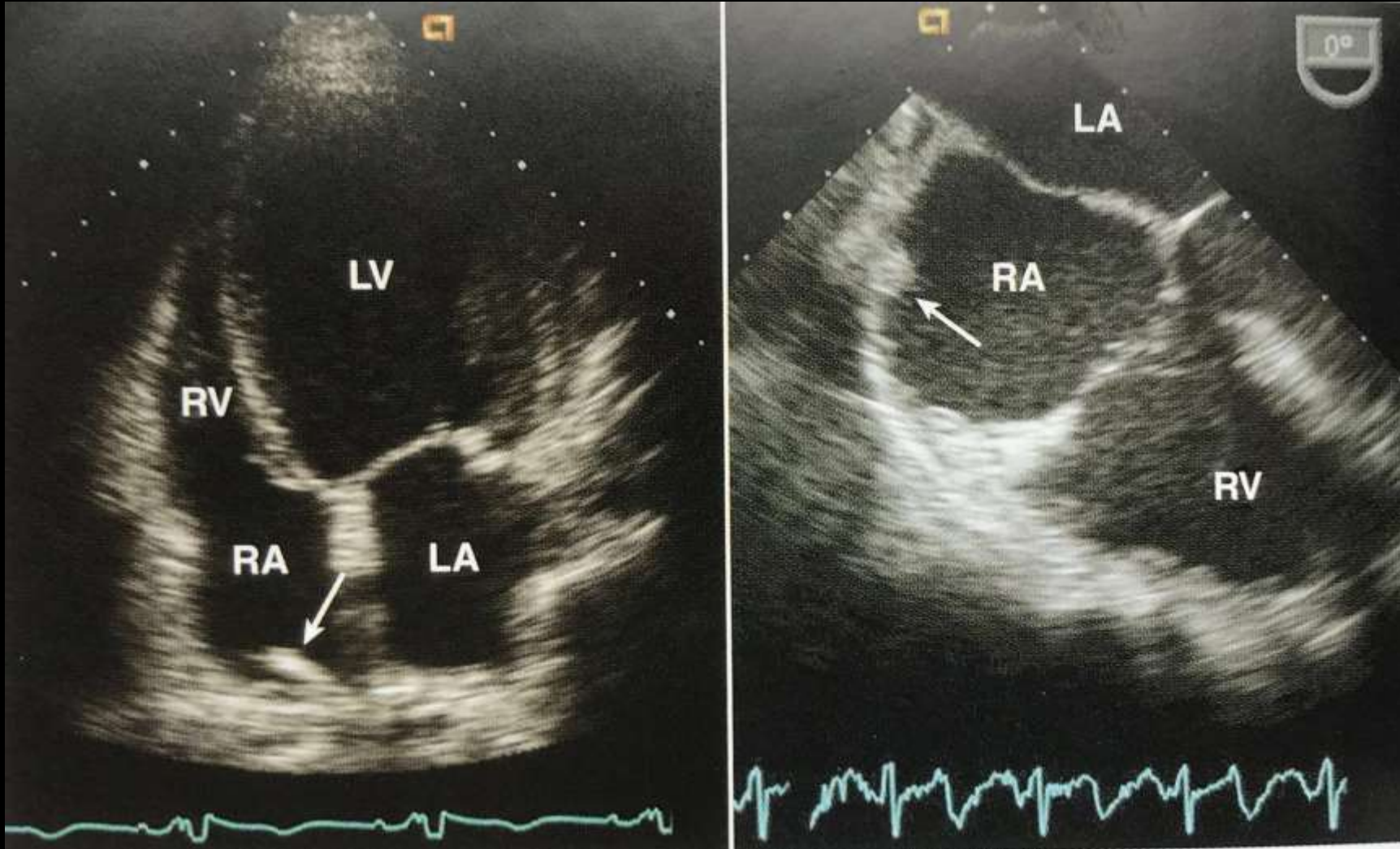
Reminder:

Superiorly/cranially: the crista terminalis

Inferiorly: the Eustachian Valve, the coronary sinus valve (Thebesian valve) and Chiari network



Crista Terminalis



02/22/19 07:56:55AM ADM JB, 022219-075004AM

GE
L6

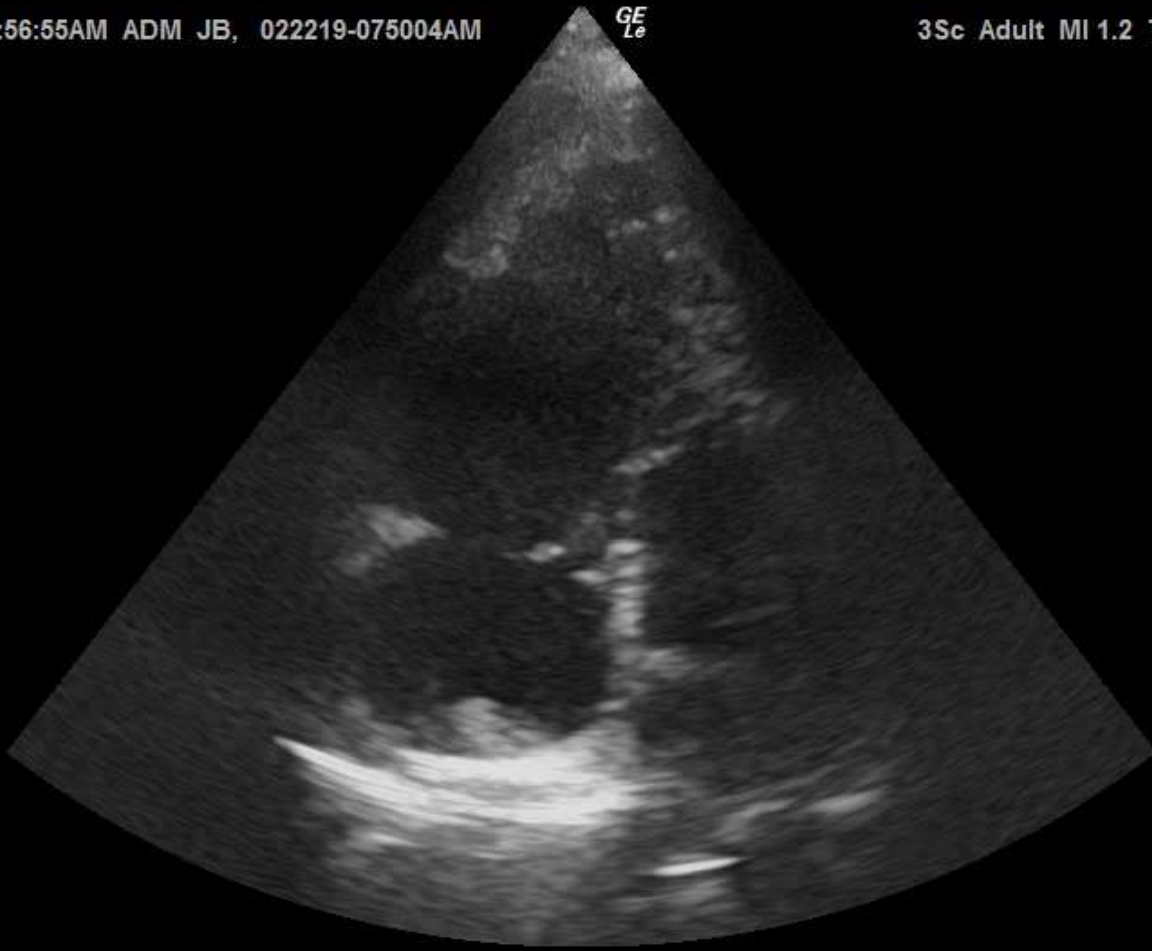
3Sc Adult MI 1.2 TIs 0.1

0-

5M

10-

15-



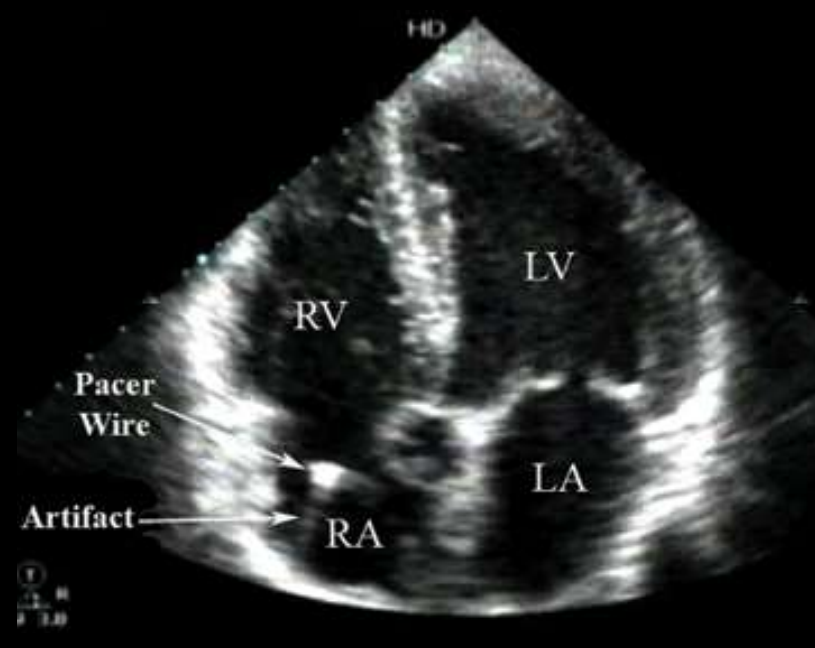
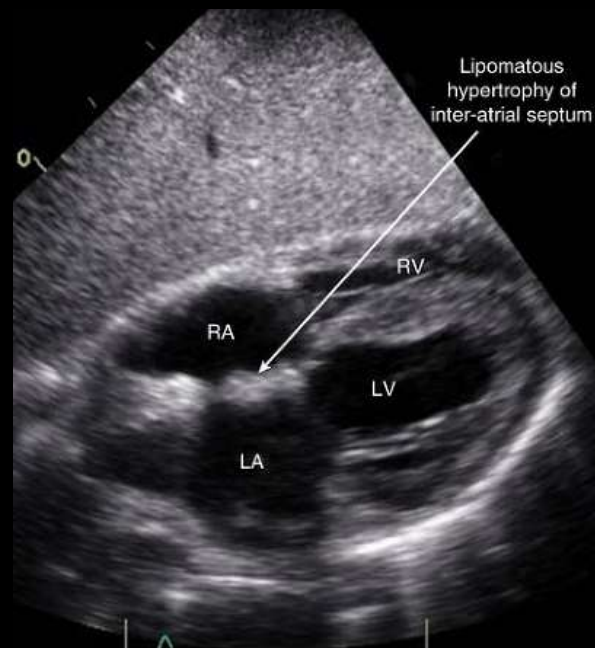
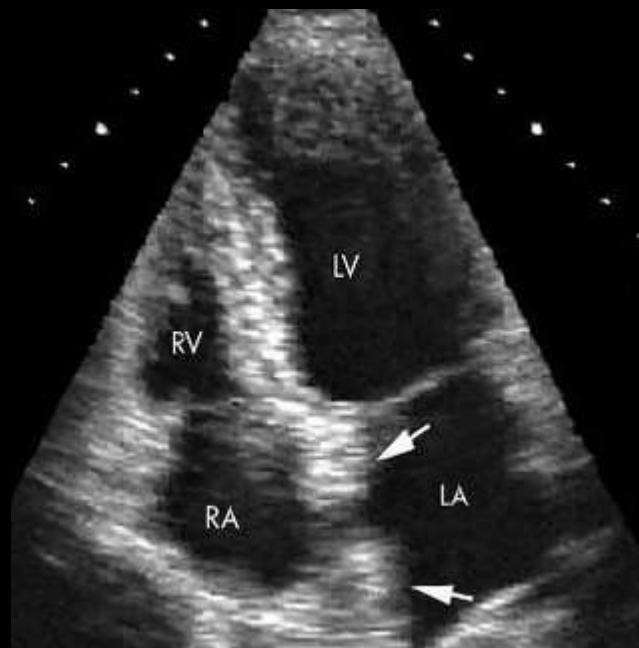
Other benign right atrial findings

Catheters/pacemaker leads

Lipomatous hypertrophy of interatrial septum

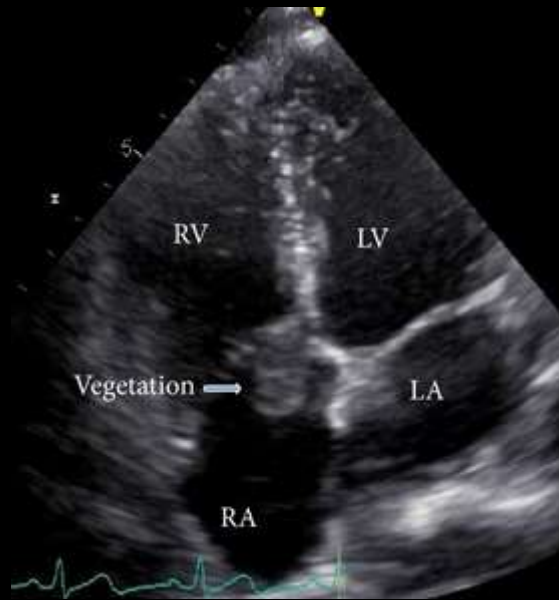
Pectinate muscles

Fatty material (surrounding the tricuspid annulus)



And not so benign

Endocarditis/infected thrombi



A patient in SDU with tunneled femoral HD catheter and hypotension during dialysis

04/17/19 11:09:09AM ADM

GE
Le

3Sc Adult MI 1.2 TIs 0.1

0-

5M

10-

M

15-



04/17/19 11:09:25AM ADM

GE

3Sc Adult MI 1.2 TIs 0.1

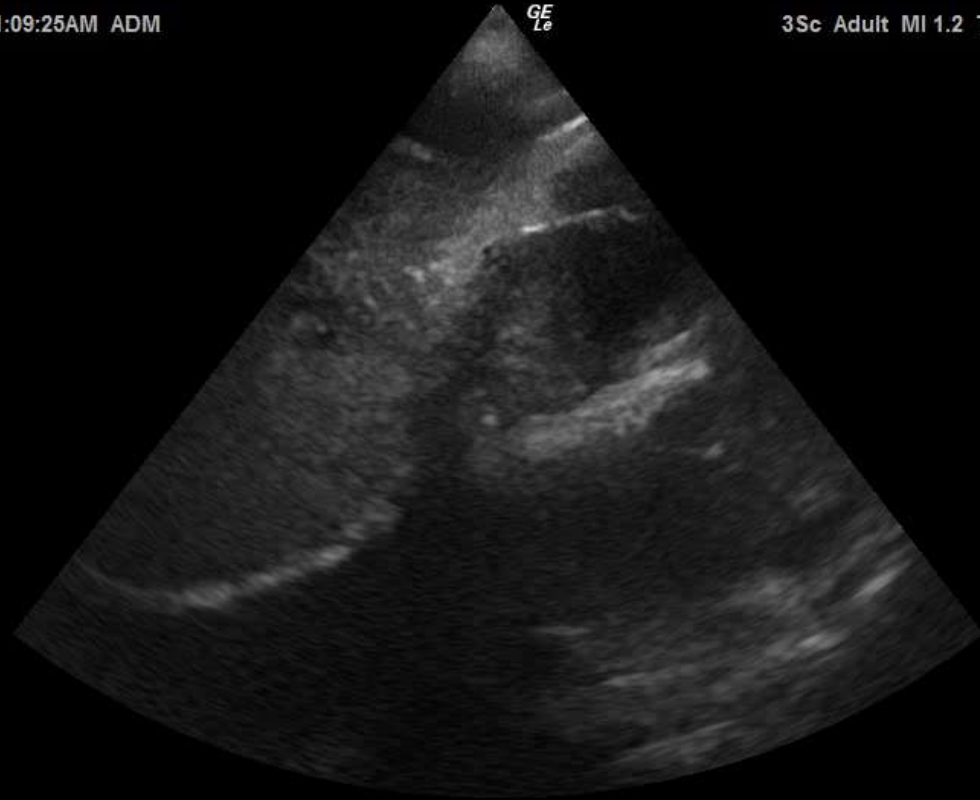
0-

5M

10-

M

15-



Back to our patient....

Blood cultures all negative

Clinically stable, afebrile throughout hospitalization

Bone cultures from grew Strep parasanguinis

**Discharged on Ceftriaxone 2g Q24h for 6 weeks with ID
follow up**

Take home points

Always evaluate POCUS findings in the clinical context

Be aware of anatomical variants that mimic pathology

References

- Kim MJ, Jung HO. Anatomic variants mimicking pathology on echocardiography: differential diagnosis. *J Cardiovasc Ultrasound*. 2013; 21(3): 103-112
- Moral S, Ballesteros E, Huguet M, Panaro A. Differential diagnosis and clinical implications of remnants of the right valve of the sinus venosus. *Journal of the American Society of Echocardiography*. Vol 29, No 3. March 2016
- Edwards AD, Voclers MA, Morgan CJ. Infective endocarditis affecting the Eustachian valve. *Br Heart J* 1986; 56: 561-2
- Alreja G, Lotfi A. Eustachian valve endocarditis: Rare case reports and review of literature. *Journal of Cardiovascular Disease research*. 2011 Vol 2, No 3
- Yavuz T, Nazli C, Kinay O, Kutsal A. Giant Eustachian valve with echocardiographic appearance of divided right atrium. *Tex Heart Inst J* 2002; 29:336-8.
- Schneider, B, Hofmann, T, Justen, MH, Chiari's Network: normal anatomic variant or risk factor for arterial embolic events? *JACC* Vol. 26, No. 1. July 1995
- Salustri A, Bakir S, Sana A, Lange, P. Prominent crista terminalis mimicking a right atrial mass: case report. *Cardiovascular ultrasound*. 2010, 8:47.
- Armstrong WF, Ryan T, Feigenbaum H. Feigenbaum's echocardiography. 7th ed. Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins; 2010, chapter 23
- Goedde T, Conetta D, Rumisek J. Chiari network entrapment of thromboemboli: congenital inferior vena cava filter. *The annals of Thoracic Surgery*. Vol 49, issue 2, 1990, pages 317-318
- Powell E, Mullaney J. The Chiari network and the valve of the inferior vena cava. *Br Heart J*. 1960 sep; 22(4): 579-584

Thank you !!!

