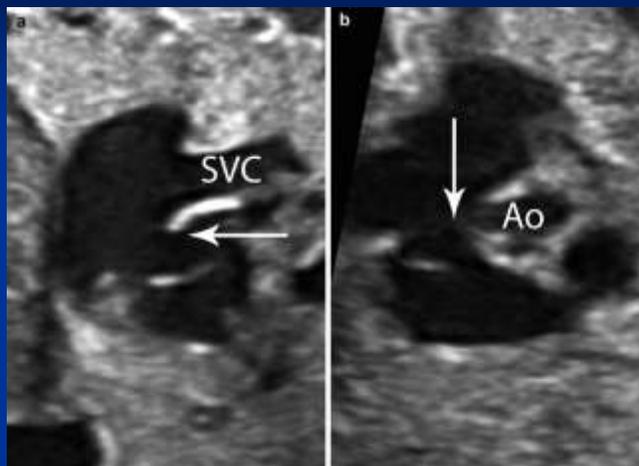


**Trans-Catheter PFO Closure**  
**Step by Step**

by  
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 Tanta University

**PFO is an integral part of normal fetal circulation.**



Fetal Echocardiograms at 20 weeks gestation demonstrating the inferior and posterior attachment of the flap of the foramen ovale leaving it free to open anteriorly and superiorly allowing inferior caval blood to cross the atrial septum.

**A**t birth, loss of the placenta decreases inferior vena caval return and increases systemic resistance, pulmonary resistance falls and pulmonary venous return increases as all systemic venous return passes through the right ventricle, increased pulmonary venous return causes an increase in left atrial pressure and functionally closes the valve of foramen ovale

Once the valve of the foramen ovale is in apposition to the former septum secundum, the valve becomes adherent over several months resulting in permanent closure.

**However, P**atency may persist into adult life in 25 % of adults.

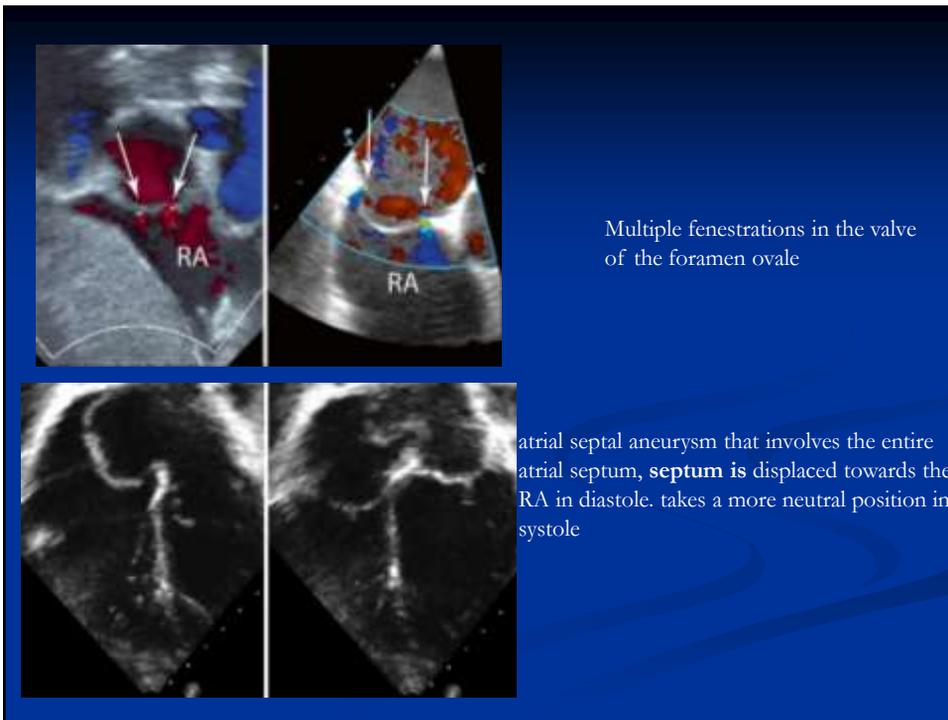
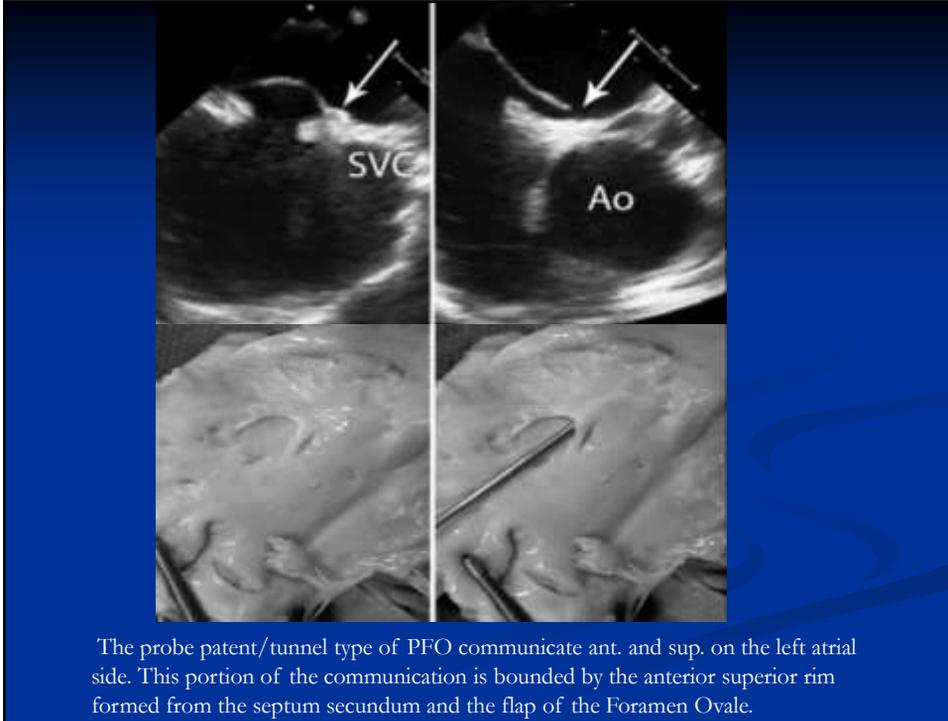
## **Anatomical Variation**

1-Lack of fusion only at the most anterior superior margin (the classic “probe patent” foramen ovale)

2-Failure of fusion across the entire anterior superior margin.

3-Fenestrations of the flap of the foramen ovale.

4-Excessive mobility of the flap (aneurysm of the atrial septum).



## Guidelines ;American Academy Of Neurology

**PFO** is not associated with increased risk of subsequent Stroke or death among medically treated patients with **cryptogenic stroke**. However having both PFO and Atrial Septal Abnormalities possibly increased risk of subsequent stroke in medically treated patients who are less than 55 years of age.

Therefore, in younger stroke patients, studies which can identify PFO or ASA, Closure may be considered for prognostic purpose.

*That is why the book of PFO closure has not been closed, but somehow it is still being picked up*

•N Eng j Med 2013;368:1092-1100

- Meticulous **workup** to exclude any etiology that may induce a stroke;
- Laboratory investigation (**hyper-coagulable state**)
- X- ray
- Carotid Duplex
- MRI
- Full TTE/TEE

### TO CLOSE OR NOT!

A combination of both **Trans-Oesophageal Echo and TransCranial Doppler**

## Detection of Right to Left Shunt

### TEE :

**Type- Length – Width- Rims**

**Patency** :Agitated Saline more than 10 bubbles in the first 3 cardiac cycle

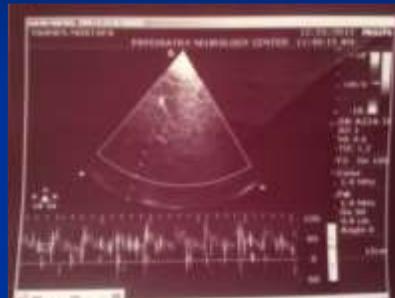
### TCD :

With agitated saline to detect the no of MES at rest and with Valsava manoeuvre, the saline is injected 5 sec before the strain  
The time needed for the agent from the antecubital vein to MCA is about 11 seconds for passage through an intra-cardaic shunts, about 16 seconds for passage through a pulmonary shunt

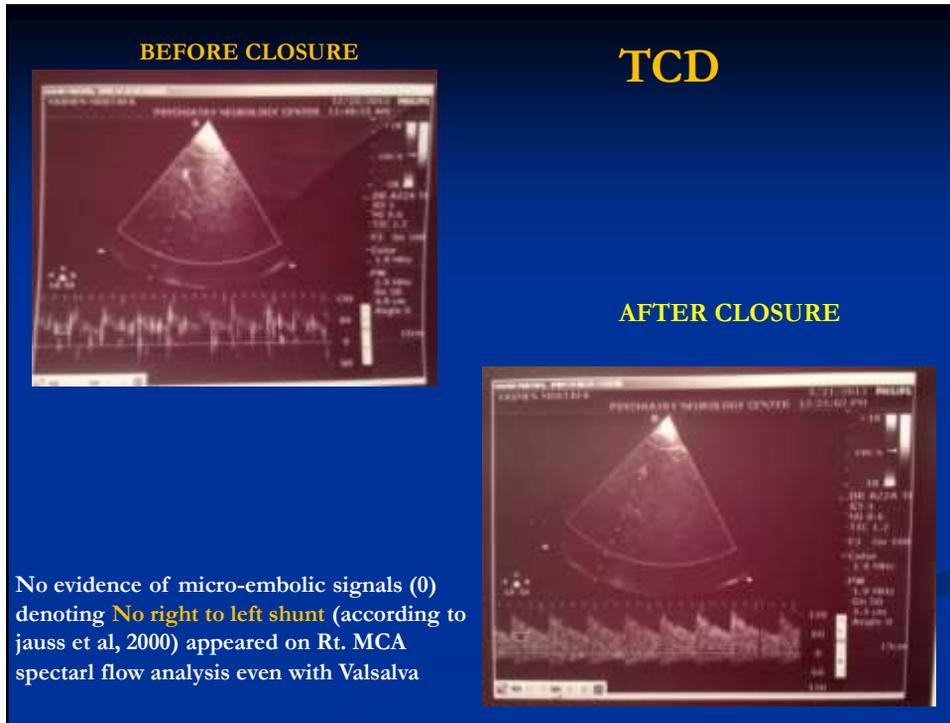
<b>Grade1</b>	No MES
<b>Grade2</b>	1-10 MES
<b>Grade3</b>	More than10
<b>Grade4</b>	Curtain



### TCD



The presence of micro-embolic signals (> 13) denoting **grade 3 right to left shunt** (according to jauss et al, 2000) appeared on RT MCA spectral flow analysis without and with Valsalva maneuver, it turned into curtain



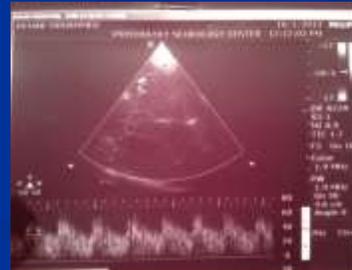
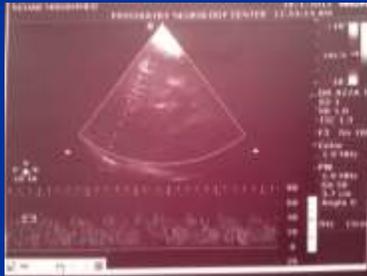
**A patient with recurrent cryptogenic stroke with TTT**

**TEE: Tinny tunnel shaped PFO**

**TCD:** presence of micro-embolic signals (7 - 13) denoting **grade 2 to 3 right to left shunt** (according to jauss et al, 2000) appeared on RT MCA (spectral flow analysis without and with valsalva maneuver increase to grade 3)

## Tanscranial Doppler a day After Closure revealed :

NO micro-embolic signals denoting **no right to left shunt** (according to Jauss et al, 2000) appeared on Rt. MCA spectral flow analysis even with valsalva maneuver.



## Conclusion

- **PFO** could induce stroke in selected situations.
- PFO Closure still an Open Question
- Meticulous Selection of the **CANDIDATES**  
**TEE** and **TCD**
- Long term follow up is mandatory.



•100 Patients Diagnosed as PFO inducing cryptogenic stroke  
 of had migraine aura, 30 had Cryptogenic Stroke  
 had two recurrent strokes on anticoagulants

•Sex ; female and males

•Age; 12 to 51 years old

•All had meticulous workup to exclude any etiology that may induce a stroke;  
 Laboratory investigation (hyper-coagulable state)

X- ray

Carotid Duplex

MRI

Full TTE/TEE

**TO CLOSE OR NOT!**

**A combination of both Trans-Oesophageal Echo and  
 TransCranial Doppler**

## Guidelines ;American Academy Of Neurology

**Strong Evidence Supports** For patients who have had a cryptogenic stroke and have a PFO.

Indicates that the risk of subsequent stroke or death is no different from other cryptogenic stroke patients **WITHOUT** PFO when treated medically with antiplatelet or anticoagulants. (Level A\*).

**Weak Evidence Supports** It is possible that the combination of PFO or ASA confers an increased risk of subsequent stroke in medically treated patients who are less than 55 years of age. Therefore, in younger stroke patients, studies which can identify PFO or ASA, Closure may be considered for prognostic purpose (Level C).

**RESPECT** trial, out of the 980 patients randomized to PFO closure vs. TTT and followed for 2.5 years, those in TTT arm had non sig. 51% reduced risk of recurrent stroke

**PC** trial, 414 patients randomized to PFO closure vs. TTT And followed for 4 years, closing PFO resulted in non sig. 37% reduced risk of recurrent stroke

**Closure** trial had equal results

*Those negative results should have closed the book PFO closure but somehow it is still being picked up*

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**May we need to create a hole To close PFO!!**

**Tans-cranial Doppler revealed :**

The presence of micro-embolic signals (7 - 13) denoting **grade 2 to 3 right to left shunt** (according to jauss et al, 2000) appeared on RT MCA spectral flow analysis without and with valsalva maneuver increase to grade 3

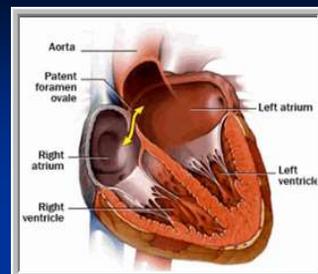
## Follow UP

## Second Stroke

**PFO** is a remnant of the fetal circulation. Oxygenated placental blood enters (RA) via (IVC) and crosses the valve of the foramen ovale to enter the systemic arterial system .

At birth, PVR drop with a reversal of the (LA) pressure gradient. The flap of the foramen ovale (septum primum) closes against the atrial septum (septum secundum) fusion usually occurring within the first two years of life

Fusion is incomplete in about 25% of people, resulting in an oblique slit-like defect. Termed a PFO, it functions as a valve-like structure with the "door-jam" on the LA side of the atrial septum



## Guidelines ;American academy of neurology

- **PFO is not associated with increased risk of subsequent stroke or death among medically treated patients with cryptogenic stroke.** However, having both PFO and atrial septal abnormalities possibly increases the risk of subsequent stroke (but not death) in medically treated patients younger than 55 years.
- **In patients with a cryptogenic stroke and an atrial septal abnormality, the evidence is insufficient to determine if warfarin or aspirin is superior in preventing recurrent stroke or death, but minor bleeding is more frequent with warfarin.** There is insufficient evidence to evaluate the efficacy of surgical or endovascular closure.

**Strong evidence supports** For patients who have had a cryptogenic stroke and have a PFO, indicates that the risk of subsequent stroke or death is no different from other cryptogenic stroke patients without PFO when treated medically with antiplatelet agents or anticoagulants. Therefore, in persons with a cryptogenic stroke receiving such therapy, neurologists should communicate to patients and their families that presence of PFO does not confer an increased risk for subsequent stroke compared to other cryptogenic stroke patients without atrial abnormalities **(Level A\*)**.

**Weak evidence supports** However, it is possible that the combination of PFO and atrial septal confers an increased risk of subsequent stroke in medically treated patients who are less than 55 years of age. Therefore, in younger stroke patients, studies which can identify PFO or atrial septal aneurysm may be considered for prognostic purpose (level c)



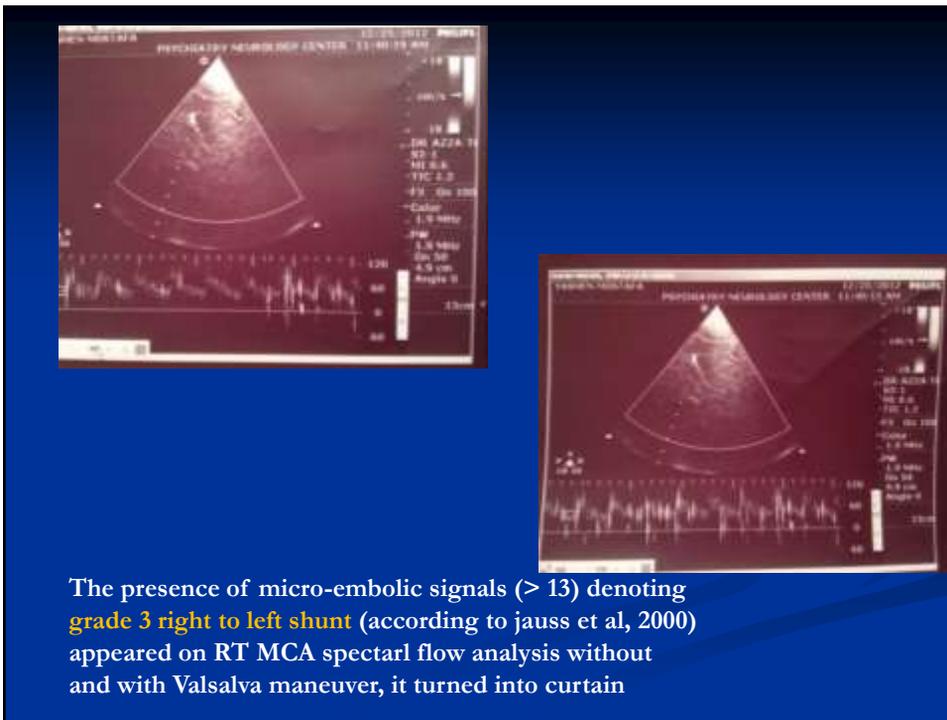
## Home Message











## outlines

- Transcatheter ASD closure
- Balloon sizing has been integral part of the intervention
- Historically pulled back technique to stop flow
- Papers say equal
- My TEE
- My cases

## DEVELOPMENT OF INTERATRIAL SEPTUM

# PFO

When Neurologist and cardiologist collaborate to improve patient care



## DEVELOPMENT OF INTERATRIAL SEPTUM