TOE for percutaneous closure of septal defect (ASD, VSD)
Conflict of interest

- None
Introduction

- Atrial septal defect
- Ventricular septal defect

The input of the sonographer is essential in percutaneous septal procedures!!

Sonographer + Interventionalist =

- Safety
- Efficiency
- Efficacy
The general idea

- To close a defect with a device:
  - Double disk / umbrella / helex
  - (Coils)

One disk on the left
One disk on the right
Select the right patient

- Only the ASD secundum type is feasible for percutaneous closure
  - Exclude ASD primum type and ASD sinus venosus type

ASD primum type
Close to mitral valve
- Mitral valve repair -

Sinus venosus defect
SVC and pulmonary vein involved
- Atrial rerouting -
Select the right patient

- Only the ASD secundum type is feasible for percutaneous closure
  - Sizes up to 40 mm (stretched) can be closed percutaneously
    (maximal unstretched diameter + 25 to 50%)

ASD secundum type
Select the right patient

- Evaluate all rims (and measure corresponding diameters)
  - Anterior, posterior, superior, and inferior

Figure 1. Artist’s drawing of right anterior surface of heart with right atrial free wall removed. Approximate locations of 5 measured atrial septal defect rims are labeled. AAO, Ascending aorta; AI, anteroinferior; AS, anterosuperior; IVC, inferior vena cava; PI, posteroinferior; PS, posterosuperior; S, superior; SVC, superior vena cava. Mathewson et al. J Am Soc Echocardiogr 2004.

3D view from right atrium
Select the right patient

- Evaluate all rims (and measure corresponding diameter)
  - (Postero)inferior and superior rims need to be sufficient

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Select the right patient

- Evaluate all rims (and measure corresponding diameters)
  - *Posteroinferior rim* needs to be sufficient

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Select the right patient

- Evaluate all rims (and measure corresponding diameter)
  - *Anterosuperior rim* is the only rim which is not needed

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Select the right patient

- Evaluate all rims (and measure corresponding diameters)
  - *Posterosuperior and anteroinferior rims* need to be sufficient

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Select the right patient

- Evaluate all rims (and measure corresponding diameters)
  - No sufficient rims = do not send for percutaneous close!!

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Select the right patient

- Count the number of defects and describe the location and sizes of all defects separately
  - Largest defect: preferred location of single device

ASD2 with multiple orifices. (Left) Fenestrations (arrows) of the St. A large ASD2 is also present. (Right) A band of St (B) divides the ASD2 orifice (see Video 9). In the orientation icon, blue designates the y plane, red designates the x plane, and green designates the z plane. Roberson et al. J Am Soc Echocardiogr 2011.
Select the right patient

- Do not forget to exclude abnormal pulmonary venous return; all four pulmonary veins can be visualised by TOE

Left pulmonary veins

Right pulmonary veins
Guide the interventionalist

- How to cross the septum with the guide wire and where to park the wire (in the left upper pulmonary vein)
  - Largest defect: preferred location of the guide wire

3D view from left atrium

Guide wire in upper pulmonary vein
Help the interventionalist

- With balloon sizing of the defect to “stop flow”

Fluoroscopy

Waiste without color flow = stretched diameter

TOE
Help the interventionalist

- With balloon sizing of the defect to “stop flow”

Fluoroscopy

Color TOE
Persistent flow = second defect
Help the interventionalist

- Evaluate the stability/quality of all rims

Stable rims (waiste)  

No “strong” posterior rim = insufficient rim
Help the interventionalist

- Guide the deployment and positioning of the left sided disk

Warn for deployment in LAA and interference with mitral valve

Show relationship with the rims when the left sided disk is pulled against the septum
Help the interventionalist

- Guide the deployment and positioning of the left sided disk

Warn for deployment in LAA and interference with mitral valve

Show the axis of the left disk = Parallel with the axis of the septum
Help the interventionalist

- After deployment of the disks, confirm device stability

Posterior rim
Device may not touch the roof

Anteroinferior rim
Device may not interfere with the mitral valve function
Help the interventionalist

- After deployment of the right sided disk, confirm device stability

Anterosuperior rim

Insufficient anterosuperior rim
Ease the interventionalist

- Check for residual shunting

Through the device

Through a second defect

Because of undersizing
Ease the interventionalist

- Show the final implant result
Follow-up

• Evaluate
  ▪ Device position
  ▪ Device structure

• Exclude
  ▪ Residual shunting
  ▪ Pericardial effusion
  ▪ Thrombi on the device
  ▪ Endocarditis on the device
  ▪ Interference with valve function

Solysafe

Wire fracture
Select the right patient

- Muscular (congenital / post-infarction) and perimembranous VSDs are feasible for percutaneous closure
  - Exclude large inlet and doubly committed VSDs

Different types of VSD

Muscular VSD up to 24 mm
Select the right patient

- Muscular (congenital / post-infarction) and peri-membranous VSDs are feasible for percutaneous closure
  - Exclude *large inlet* and *doubly committed VSDs*

Different types of VSD

Membranous VSD up to 18 mm
Guide the interventionalist

- How to cross the septum with the catheter and the wire

Angiography left ventricle  Fluoroscopy
Guide the interventionalist

- How to cross the septum with the catheter and the wire

Catheter through the aortic valve
Catheter through the PM VSD into the pulmonary artery
The interventionalist alone

- To complete the veno-arterial rail (femoral/jugular-femoral)

Fluoroscopy

No image: outside the echo field
Guide the interventionalist

- Measure the diameter of the defect and help to choose the size of the device
  - Before or after wire positioning
  - With or without balloon sizing

Perimembranous VSD
Muscular VSD
Help the interventionalist

- Guide the deployment of the left and right sided disk of the device; reassure device position

Fluoroscopy

TOE: device still attached
Ease the interventionalist

- Confirm correct device size and exclude interference with surrounding valves (aortic valve, tricuspid valve); give green light to release the device

Too small

Aortic valve regurgitation
Ease the interventionalist

- Show nice images...

TOE device in PM position

TOE device in muscular position
Follow-up

- Evaluate
  - Device position
  - Device structure

- Exclude
  - Residual shunting
  - Pericardial effusion
  - Thrombi on the device
  - Endocarditis on the device
  - Interference with valve function

![Thrombus on device](image)
Conclusions

• The help of a sonographer during a percutaneous septal closure procedure is extremely useful
  ▪ To increase feasibility
  ▪ To increase efficiency and efficacy
  ▪ To lower complication rates

• The sonographer must have knowledge of the procedure and must think in the same way as the interventionalist

• Teamwork = the idea