Percutaneus ASD closure with the UltraICE Intracardiac Echocardiography Support

Our experience of percutaneus ASD closure started at 2003 by Vyacheslav Buzaev

UltraICE techique by professor E. Onorato (Italy)

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Female patient,

43 years old,

suffered from dispnea at physical exercise

At 23 y/o: surgical atrial septal defect closure with no details about operation

TEE: residual shunt with Qp/Qs 1,9 and right atrium dilatation (4.8x3.8 cm).

First percutaneus closure attempt with TTE and TEE

24 mm sizing balloon until the stop of the shunt: 14.4mm

16 mm Amplatzer ASD device was not attached securely and withdrawn

Second attempt was planned

ASD closure key factors

Anatomy
Size and device type
Implantation technique

Full ASD closure +
No complications
- device malaposition
- embolisation
- arrhythmia
- tamponade
- residual flow
- trombus
- erosion

[Chessa et al. in J Am Coll Cardiol 39:1061-1065, 2002, Co-Burn and William in Moss and Adams' Heart disease in infants, children and adolescents including fetus and young adults. Williams and Wilkins, Baltimore, 1995]

Factors of anatomy:

Rims
Defect size
Muscular rims
Fossa ovalis size
Septum aneurisms
Septum size
Abnormal pulmonary vein
Eustaqian valve

Complications:

- device malaposition
- embolisation
- arrhythmia
- tamponade
- residual flow
- trombus
- erosion

complications
are rare

Really rare?

Turk Kardiyol Dern Ars. 2013 Dec;41(8):705-13. doi: 10.5543/tkda.2013.84031.

[Percutaneous closure of secundum atrial septal defects in pediatric and adult patients: short- and mid-term follow-up results].

[Article in Turkish]
Kaya Y[1], Yurtdas M[2], Ceylan Y[3], Bulut MO[4], Söylemez N[5], Güvenç TS[6], Karakurt A[6], Akdemir R[7], Oztürk H[6], Güneş Y[7], Balcı B[6], Ozkan M[6].

Author information

Abstract

OBJECTIVES: We aimed to evaluate the short- and mid-term results of patients with atrial septal defect (ASD) who were treated with percutaneous closure.

STUDY DESIGN: Seventy-nine patients with secundum ASD (54 female and 25 male; mean age 26.2±17.2; range 3 to 71] years) were included in this study. Patients were evaluated by transthoracic (TTE) and/or transesophageal echocardiography (TEE). Amplatzer septal occluder (ASO) was used in all patients. In 76 patients, the procedure was performed under local anesthesia with TTE, while in the other 3 patients, it was performed with general anesthesia with TEE. Patients were followed up at the 1st, 3rd, 6th and 12th months and annually thereafter. Mean follow-up time was 13.6±6.6 months.

RESULTS: Mean diameter of ASDs was 18.2±7.5 mm and 20.7±8.04 mm during balloon dilatation, and mean diameter of implanted devices was 22.7±8.5 mm. Procedural time was 40.2±12.6 minutes and fluoroscopy time was 10.9±4.1 minutes. The procedure was successfully performed in all patients (100%). One patient with cardiac tamponade died seven days after cardiac surgery. In two patients, the implanted devices embolized to the pulmonary circulation. Residual flow was found in three patients immediately after the procedure, without residual shunts one month after closure. Mild pericardial effusion in one patient and significant residual shunt due to device malposition in another were discovered during the follow-up at 1 and 6 months, respectively, after the procedure.

CONCLUSION: Our findings showed that percutaneous closure of ASDs is successful in most patients with a low complication rate, and demonstrated that residual shunts do not develop in the majority of patients in the short- and mid-term.

74 successfull

later:
3 residual shunt
1 died because of tamponade
1 late malaposition

The reason:

Possible they did not see something very important

[Percutaneous closure of interatrial septal defects: mid-term follow-up results].
Oto MA, Aytemir K, Ozkutlu S, Kaya EB, Kabakcı G, Ateş AH, Yorgun H, Canpolat U.
Turk Kardiyol Dern Ars. 2011 Jul;39(5):385-95. doi: 10.5543/tkda.2011.01474. Turkish. Erratum in: Turk Kardiyol Dern Ars. 2012 Jan;40(1):110.

TTE weak points

1. Doctor
   - Hand of the doctor under fluoroscopy
   - Additional person who perform
   - Subjective

2. Visualisation
   - Bad windows, Obese, not 100% cases
   - 90 degree
   - Can miss
     - abnormal pulmonary vein
     - sinus venosus pathology
     - primary defect

TEE?

weak points

1. Patients do not like
2. Narcosis, intubation
3. Esophagus pathology
4. Limited time inserted
5. Posterior-inferior
6. 90 degree

We all want to have:

1. Visualisation
All key anatomical factors 360 degree visualisation that can decrease the x-ray dose and increase procedure quality

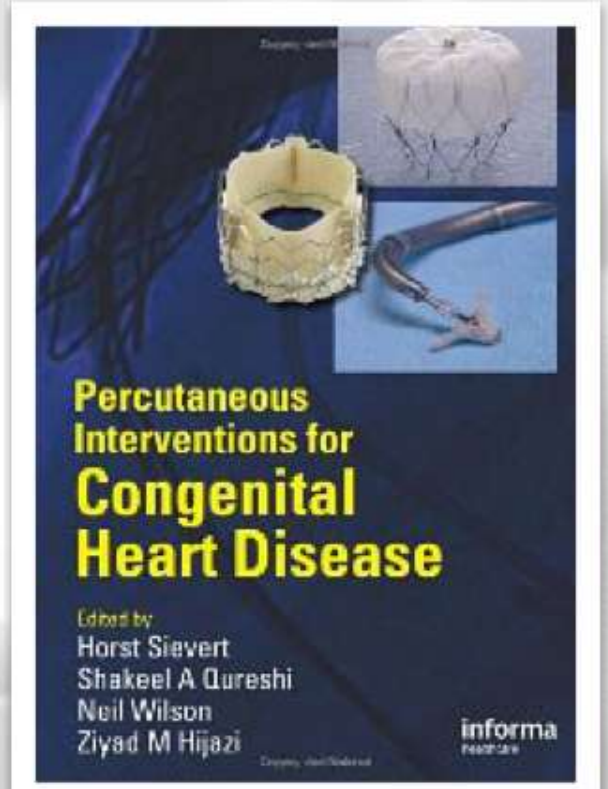
2. Comfortable for the patient and can be performed under local anaestesia as long as necessary

3. Operator himself can perform ASD closure and look

Boston Scientific
iLab
Intracardiac echo

ULTRA-ICE

- FDA 20.06.1997
- Mechanical scanning
- piezoelectric crystal
- 8.5 F
- 9 MHz
- 360°
- depth: 10 cm
- single use



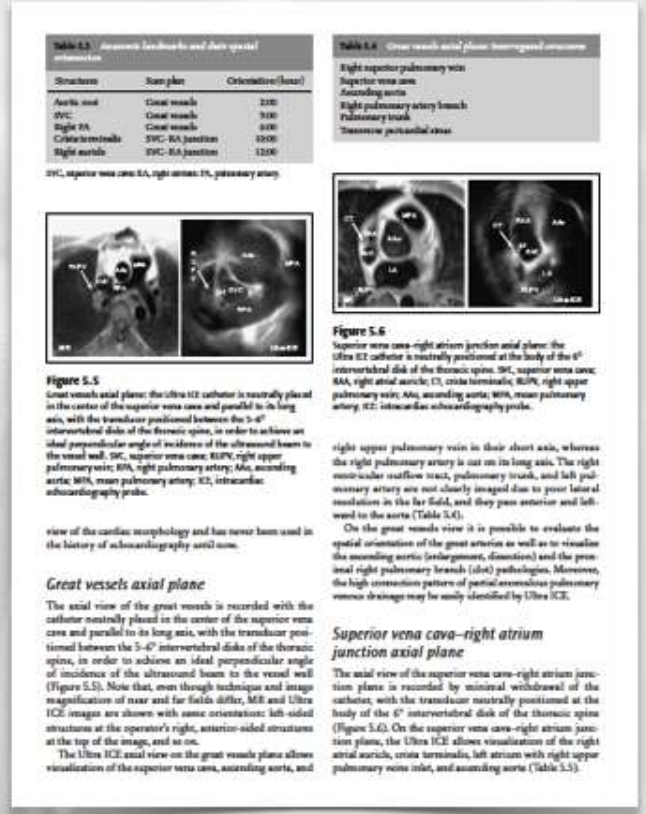


Table 5.3 Anatomic landmarks and their spatial orientation

Structures	Scan plan	Orientation (hour)
Aortic root	Great vessels	2:00
SVC	Great vessels	9:00
Right PA	Great vessels	4:00
Crista terminalis	SVC–RA junction	10:00
Right auricle	SVC–RA junction	12:00

SVC, superior vena cava; RA, right atrium; PA, pulmonary artery.

Table 5.4 Great vessels axial plane: heart-ground structures

Right superior pulmonary vein
Superior vena cava
Ascending aorta
Right pulmonary artery branch
Pulmonary trunk
Transverse pericardial sinus

Figure 5.5
Great vessels axial plane: the Ultra ICE catheter is neutrally placed in the center of the superior vena cava and parallel to its long axis, with the transducer positioned between the 3–4° intervertebral disks of the thoracic spine, in order to achieve an ideal perpendicular angle of incidence of the ultrasound beam to the vessel wall. SVC, superior vena cava; RUPV, right upper pulmonary vein; RPA, right pulmonary artery; AAo, ascending aorta; MPA, mean pulmonary artery; ICE, intracardiac echocardiography probe.

Figure 5.6
Superior vena cava–right atrium junction axial plane: the Ultra ICE catheter is neutrally positioned at the body of the 6° intervertebral disk of the thoracic spine. SVC, superior vena cava; RAA, right atrial auricle; CT, crista terminalis; RUPV, right upper pulmonary vein; AAo, ascending aorta; MPA, mean pulmonary artery; ICE: intracardiac echocardiography probe.

view of the cardiac morphology and has never been used in the history of echocardiography until now.

Great vessels axial plane

The axial view of the great vessels is recorded with the catheter neutrally placed in the center of the superior vena cava and parallel to its long axis, with the transducer positioned between the 3–4° intervertebral disks of the thoracic spine, in order to achieve an ideal perpendicular angle of incidence of the ultrasound beam to the vessel wall (Figure 5.5). Note that, even though technique and image magnification of near and far fields differ, ME and Ultra ICE images are shown with same orientation: left-sided structures at the operator's right, anterior-sided structures at the top of the image, and so on.

The Ultra ICE axial view on the great vessels plane allows visualization of the superior vena cava, ascending aorta, and right upper pulmonary vein in their short axis, whereas the right pulmonary artery is cut on its long axis. The right ventricular outflow tract, pulmonary trunk, and left pulmonary artery are not clearly imaged due to poor lateral resolution in the far field, and they pass anterior and leftward to the aorta (Table 5.4).

On the great vessels view it is possible to evaluate the spatial orientation of the great arteries as well as to visualize the ascending aortic (enlargement, dissection) and the proximal right pulmonary branch (clot) pathologies. Moreover, the high connection pattern of partial anomalous pulmonary venous drainage may be easily identified by Ultra ICE.

Superior vena cava–right atrium junction axial plane

The axial view of the superior vena cava–right atrium junction plane is recorded by minimal withdrawal of the catheter, with the transducer neutrally positioned at the body of the 6° intervertebral disk of the thoracic spine (Figure 5.6). On the superior vena cava–right atrium junction plane, the Ultra ICE allows visualization of the right atrial auricle, crista terminalis, left atrium with right upper pulmonary veins inlet, and ascending aorta (Table 5.5).

"Intracardiac Echocardiography by Ultra ICE" Section 2
IMAGING MODALITIES IN THE CATH-LAB "PERCUTANEOUS INTERVENTIONS FOR CONGENITAL HEART DISEASE"
Edited by H Sievert, SA Qureshi, N Wilson, ZM Hijazi
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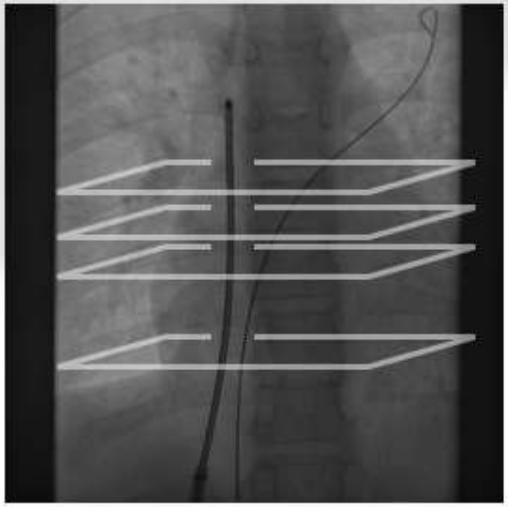
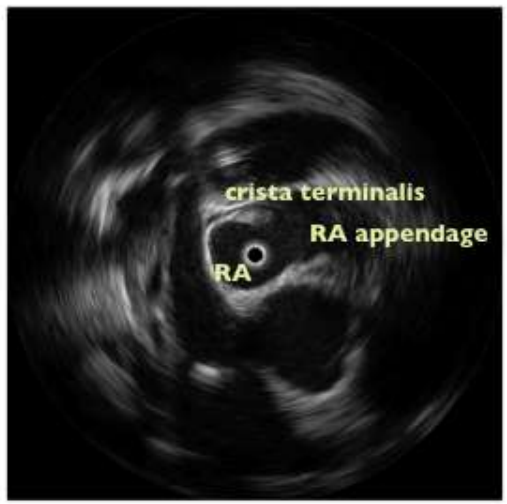
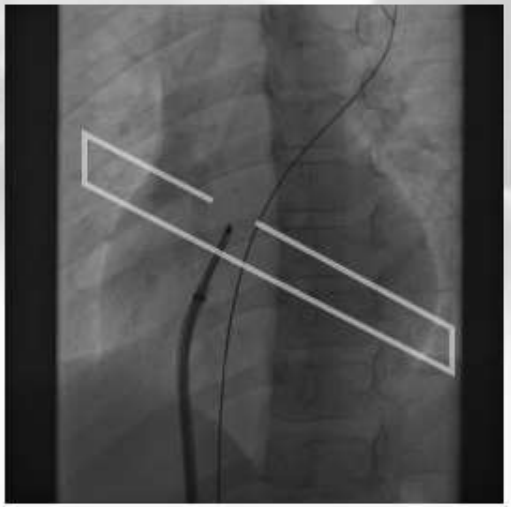
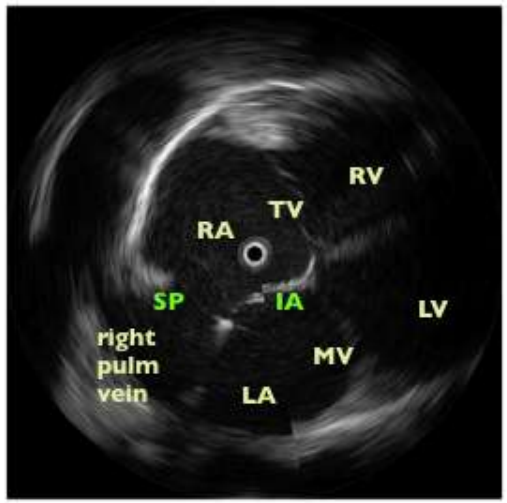
Authors: E Onorato, M Zanchetta, F Casilli

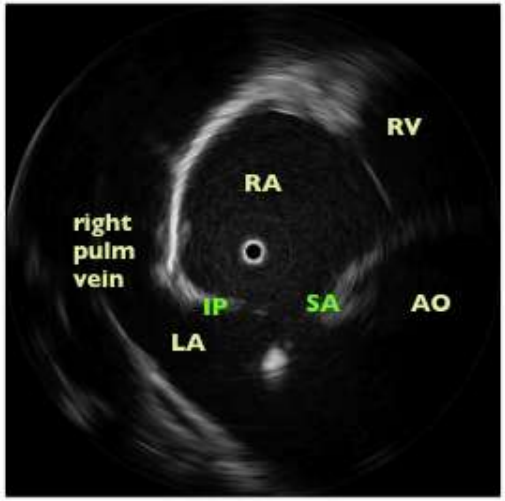




Th5-6 Main arteries
Th6 Vena cava superior - right atrial junction
Th6-7 Aortic valve
Th8 Vena cava inferior - tricuspid valve







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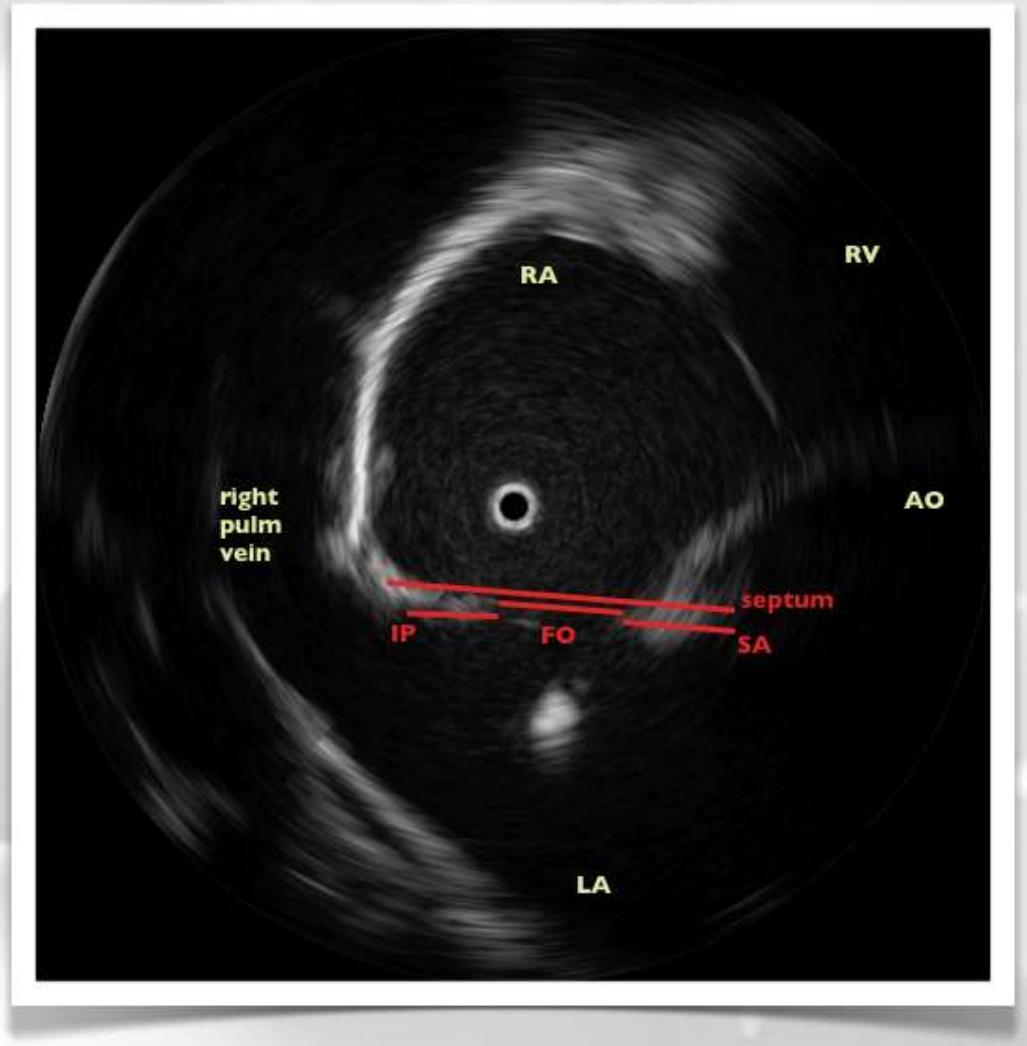
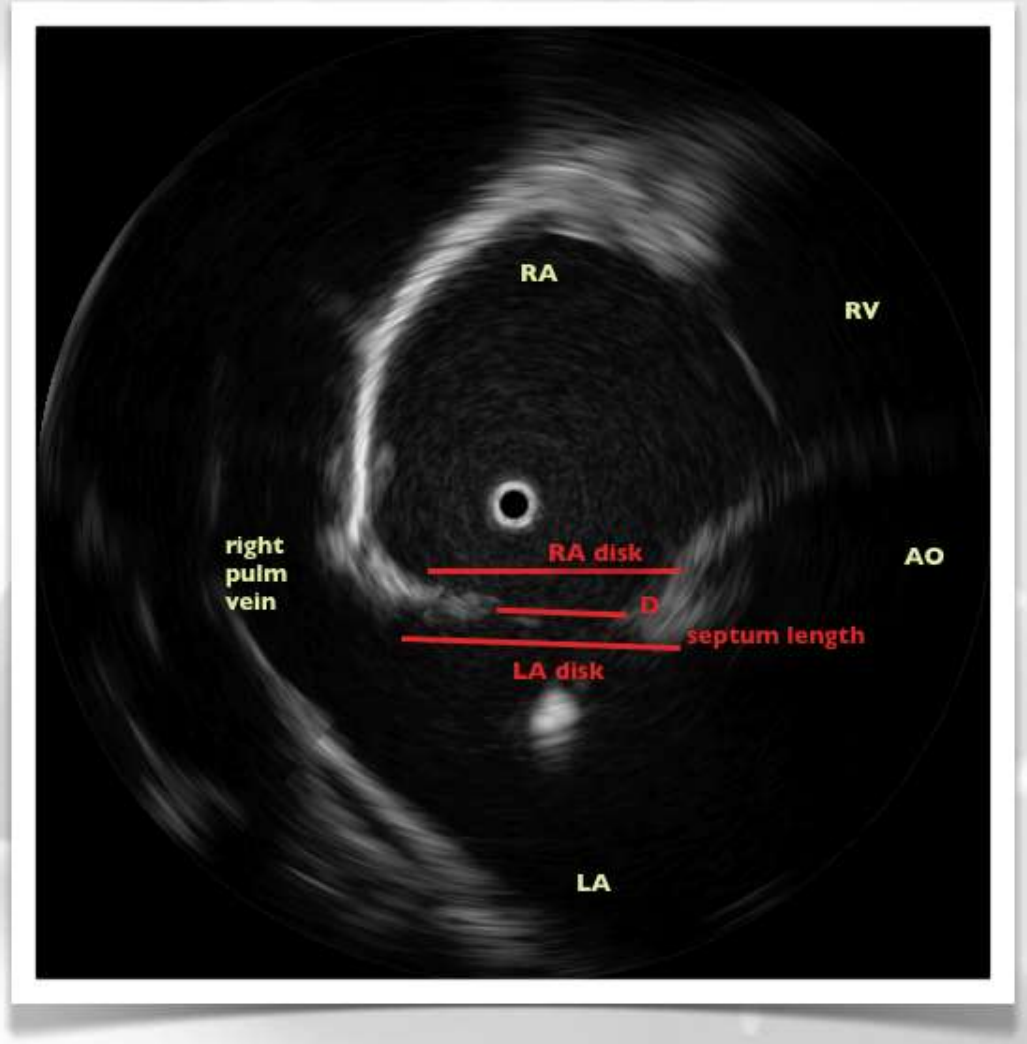


A and B is the size in these two views

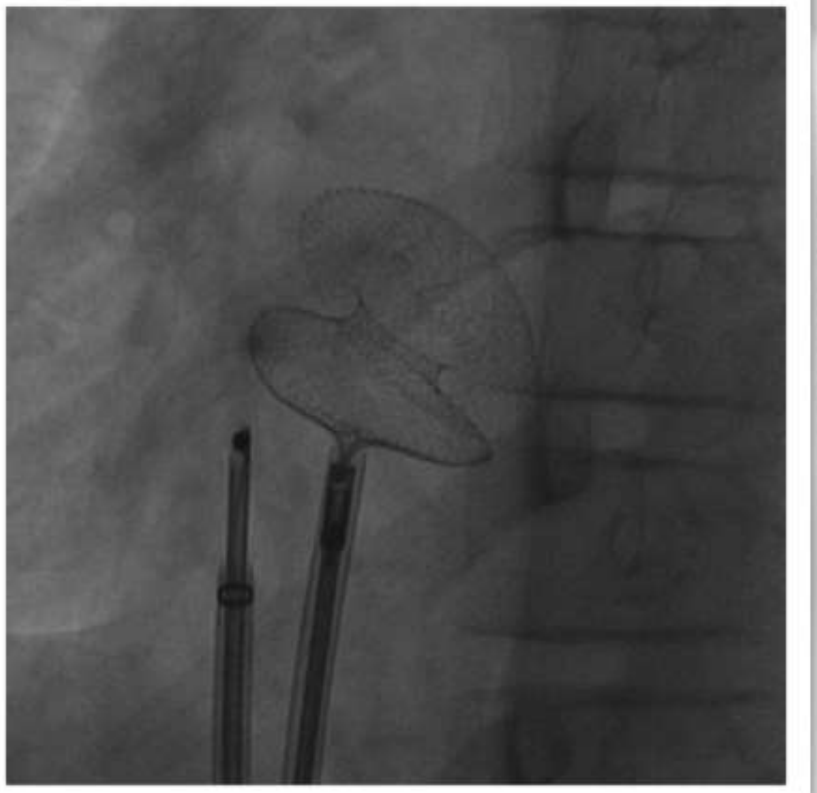
Onorato formula: The occluder size have to be:

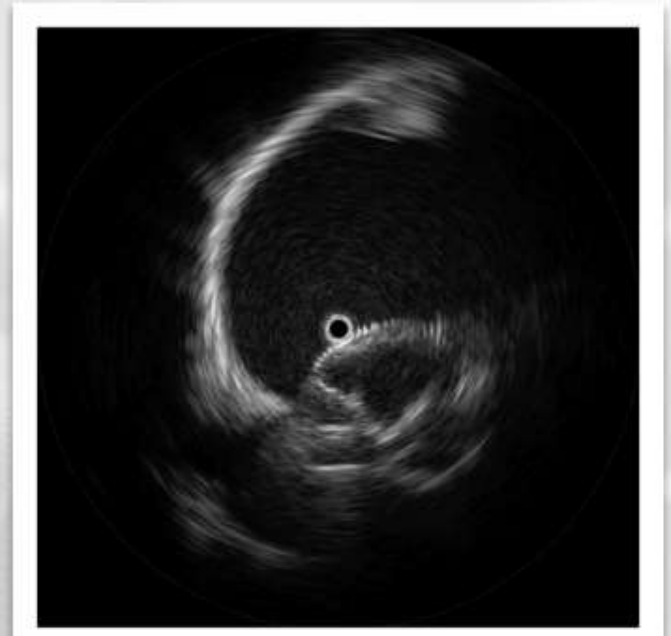
$D = SQRT (A \times B)$

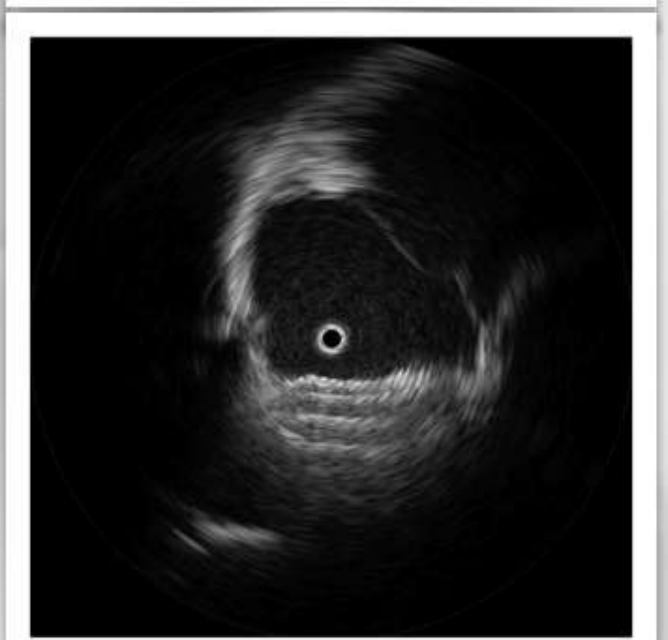


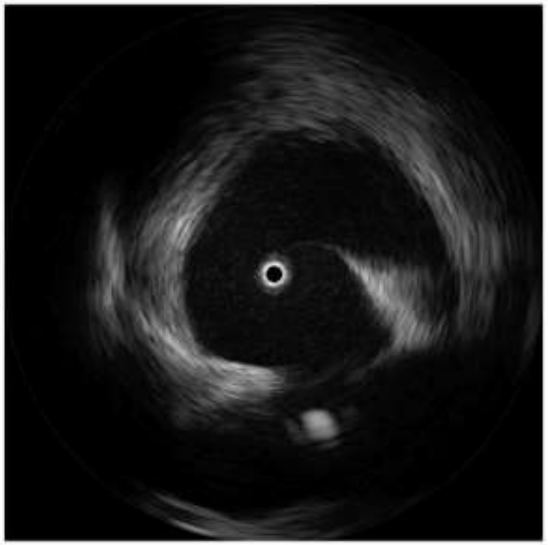
Device size is D
Adjustment
(RA and LA disk size from device manual)

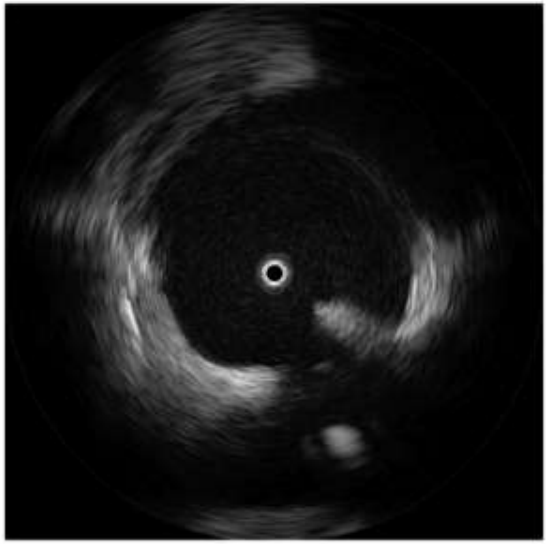
Implantation

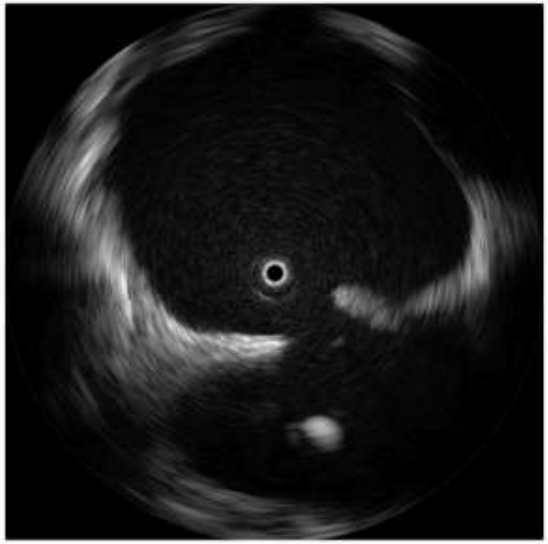


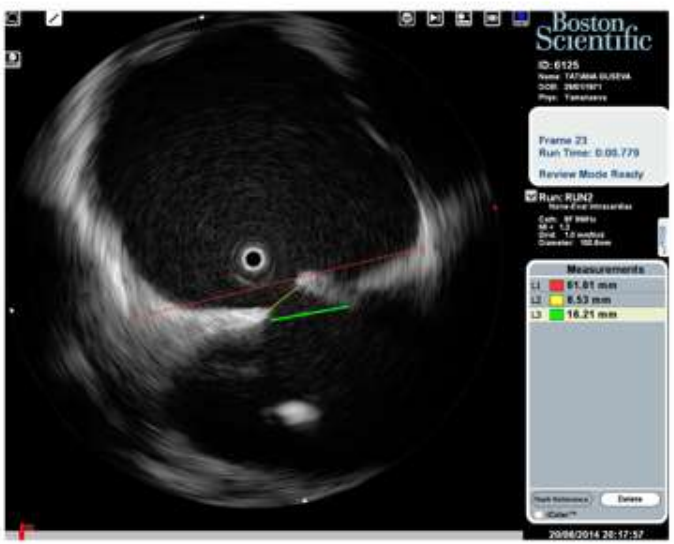


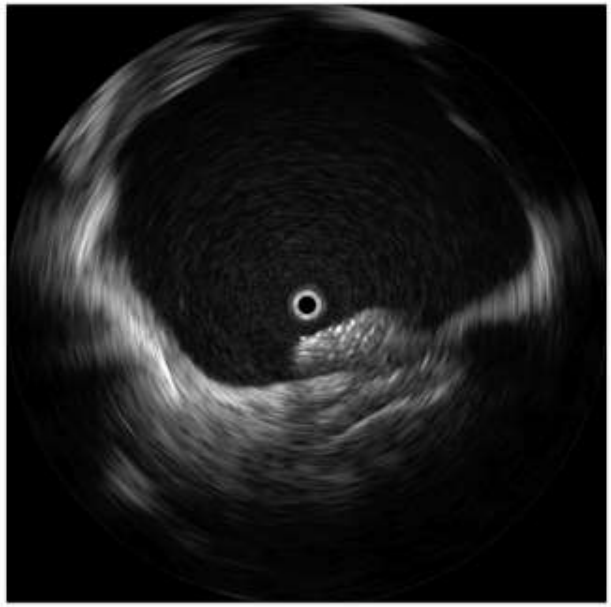












Our experience show that UltraICE is:

1. Good visualisation of all key anatomical factors 360 degree that can decrease the x-ray dose and increase quality of care

2. Comfortable for the patient and can be performed under local anaestesia as long as necessary

3. Good opportunity to do visualisation **by operator himself**

As the bonus
1. Ultra ICE can differ septum primum and secundum by intensity
2. Can show other pathology that we are not sure at TEE and TTE
3. Possible direct sizing, no balloon

Education curve is 10-15 procedures