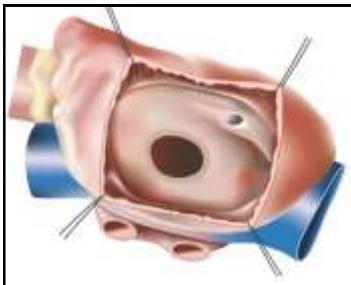

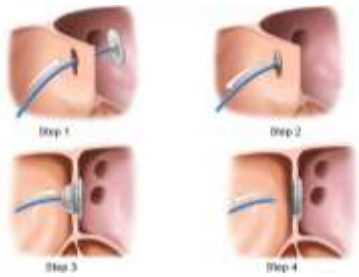

Erosion post ASD, can we predict ?

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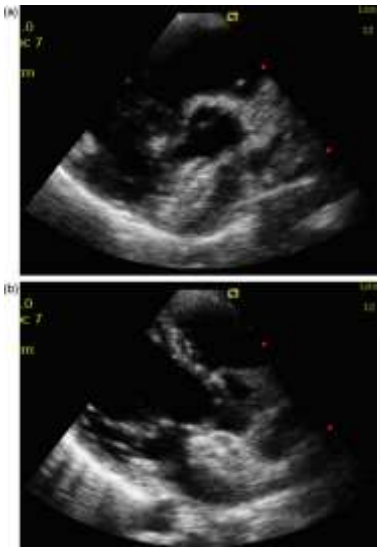
Madinah Cardiac Center SA
National Heart Institute EG
Cardio-Egypt
February 2018

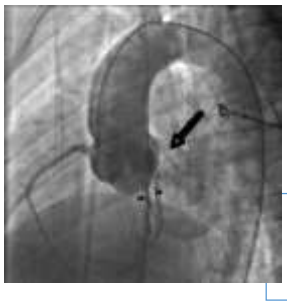
DISCLOSURE

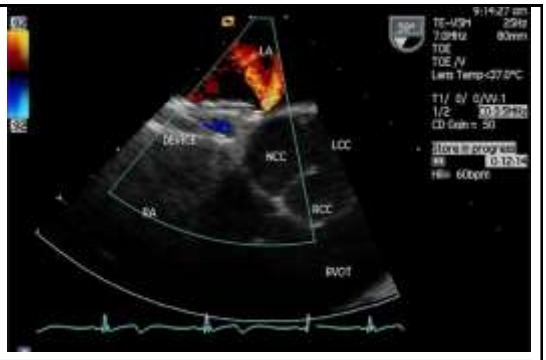
- I am a proctor to the following companies
  - St Jude
  - Abbott
  - Medtronic

- Nothing to disclose related to the following presentation

45 ys female presented with CP 3 months after ASD closure

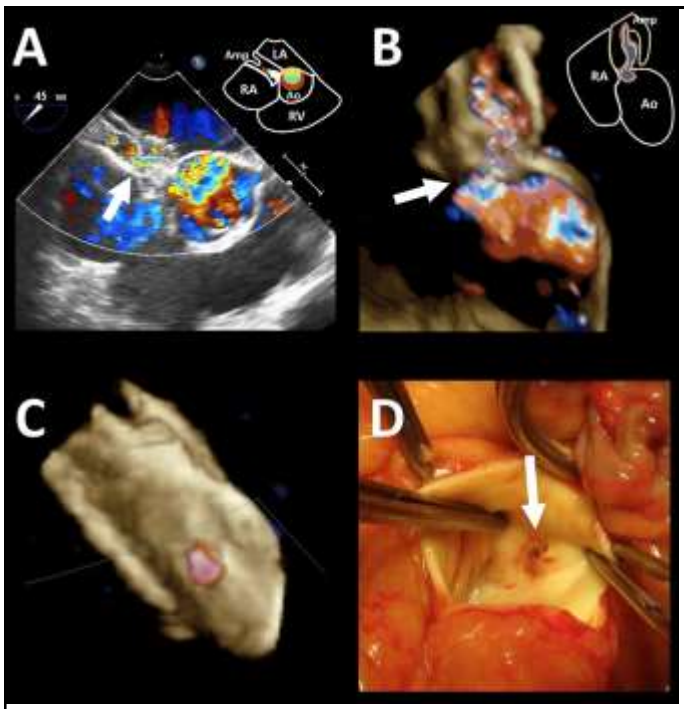






LA-AO Fistula 3 months post ASD device (26) closure

Intraoperative findings included a 4mm hole between the non-coronary sinus and the roof of the left atrium.



A)small bidirectional shunt across the device (white arrow).

(B) To clearly depict the abnormal fistulous tract,

Teacup tempest or tip of the iceberg?

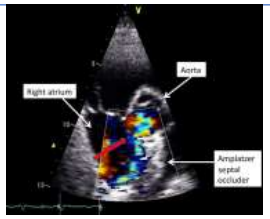
- Teacup tempest
  - Great anger or excitement about a trivial matter.
- Tip of the iceberg?

Definitions

- Cardiac erosion is a cardiac perforation following ASD device closure

A Potentially Catastrophic Event and still Unclear

Facts About Erosion

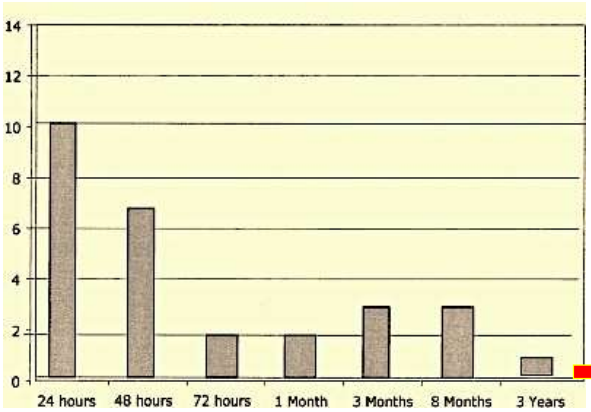


- ✓ The first report on erosion was published in 2004 .
- ✓ A total of 80 cases (till today)were reviewed.
- ✓ Erosion of the device through an atrial wall into the aorta or pericardial space
- ✓ Following device implantation, → Mechanical trauma
- ✓ Erosion-associated **death** was defined as
  - ✓ death during the acute episode (on arrival, during acute hospitalization, or
  - ✓ early after surgery to treat the erosion)
- ✓ The mortality of device closure of ASD even when accounting for erosion is lower when compared with surgery.
- ✓ Most cases of perforation necessitated surgical repair and a mortality rate of approximately 10%
- ✓ At least One erosion event reported during exercise

Patient	Sex	Age (years)	Time to symptoms (days)	Pericardial tamponade	ASD size (mm)	Stretched size (mm)	Device size (mm)	Deficient rim(s)	Perforation site
1	F	5	1	Yes	11	16	16	Aortic	Unknown
2	M	8	1	Yes	10	20	20	Aortic	RA roof/aorta
3	M	8	1	Yes	11	18	18	Aortic	LA roof
4	M	10	1	Yes	NR	12	14	Superior/aortic	Unknown
5	F	22	1	Yes	15	21	24	Aortic	RA roof/aorta
6	F	31	1	Yes	17	28	28	Unknown	LA?/aorta
7	F	38	1	Yes	16	26	26	Aortic?	LA roof
8	F	40	1	Yes	14	31	30	Superior	LA roof/aorta
9	F	40	1	Yes	29	32	36	Aortic	RUPV
10	M	53	1	No	26	34	34	Aortic	Unknown
11	F	4	2	Yes	14	19	20	Aortic	LA roof/aorta
12	M	4	2	Yes	19	17	17	Superior/aortic	LA roof/aorta
13	F	24	2	Yes	13	16	18	Superior/aortic	RA roof/aorta
14	F	10	2	Yes	14	18	20	Superior	RA roof
15	F	16	2	No	LC	LC	26	Superior/aortic	None
16	F	32	2	Yes	NR	24	28	Unknown	No
17	F	36	2	Yes	27	34	38	Aortic	RA roof/aorta
18	F	22	3	Yes	18	NR	26	Aortic	LA roof/aorta
19	F	42	3	Yes	12	17	20	Aortic	LA/RA roof
20	F	18	21	No	24	25	26	Superior/aortic	Fistula to LA
21	F	59	30	Yes	19	22	22	Superior/aortic	LA roof
22	M	10	90	No	18	26	26	Aortic	Fistula to RA
23	F	31	90	Yes	12	19	22	Superior/aortic	LA roof
24	F	40	90	Yes	22	32	34	Aortic	LA roof
25	F	17	180	No	20	25	30	Aortic	Fistula to LA
26	F	42	180	Yes	9	12	14	Aortic	LA roof
27	M	25	240	Yes	13	23	26	Aortic	RA roof/aorta
28	F	49	1,095	Yes	NR	19	24	Unknown	LA roof/aorta

LA
LA/AO
RA
RA/LA
RA/AO

Timing



Even up to 8 years

BRIEF TECHNIQUE REPORTS

Late erosion of an Amplatzer septal occluder device 6 years after placement

Nathaniel W. Taggart, MD,* Joseph A. Dearani, MD,† and Donald J. Hagler, MD,* Rochester, Minn

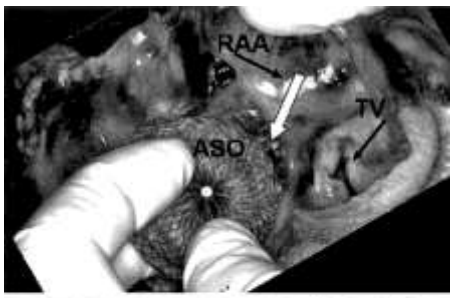
CASE REPORT · ADULT CARDIAC

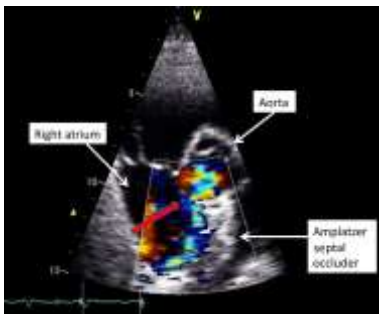
Late erosion of Amplatzer septal occluder device resulting in cardiac tamponade

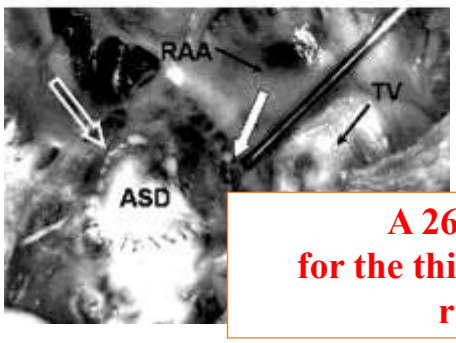
Vaikhanag Tchantchaleishvili, Amber L. Melvin, Frederick S. Ling and Peter A. Knight

Abstract

- 21% of cases in Divekar's series occurred pre-discharge,
- 69% of cases in Amin's series occurred within 72 h

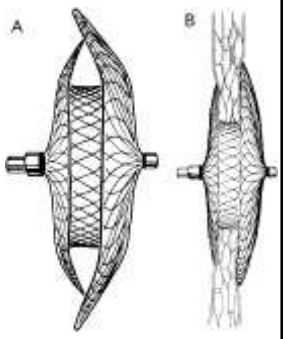




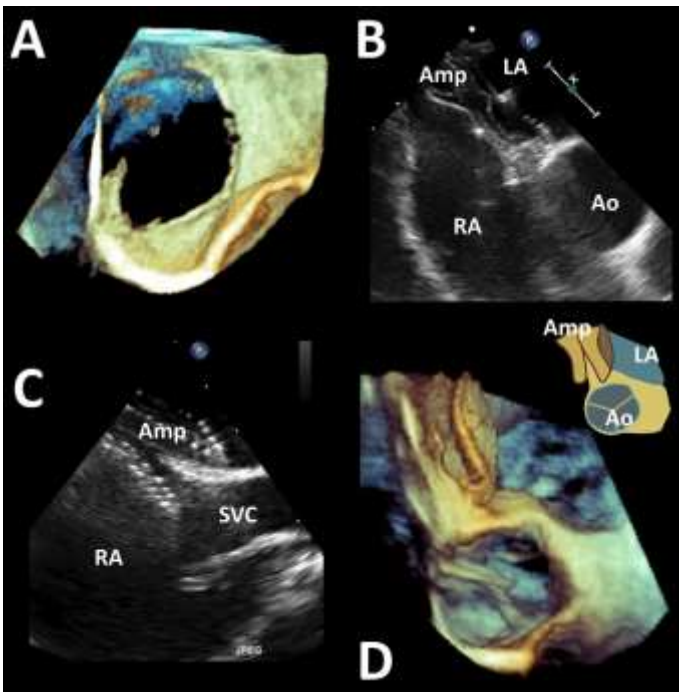


A 26-mm device, is the stiffest device for the thickness of the wire for device sizes that range from 26 through 32 mm

Facts about the The Device



- The ASO size of the device is based upon the waist .
- LA discs + 12-16 mm / RA discs + 8-10 mm
- The profile of the ASO improves and the discs of the device flatten over time.
- The flat profile occurs at the expense of waist and disc expansion.
- A very small increase in diameter may cause the edge of the device to shear on the atrial free wall.
- If the device is over-sized, acquisition of flat profile may become an important factor and may cause tissue trauma especially in cases where erosion occurs after several months to years.



Closer view after device closure

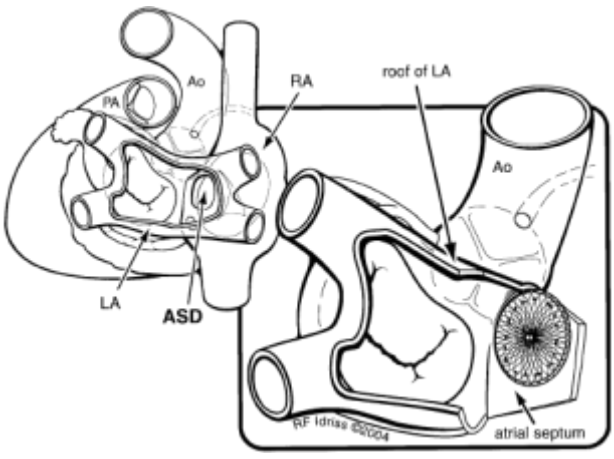
ASD anatomy. (A) Secundum ASD seen in an en face view from the right atrium. Three-dimensional image shows how the edges of the defect are rudimentary (three-dimensional zoom mode acquisition).

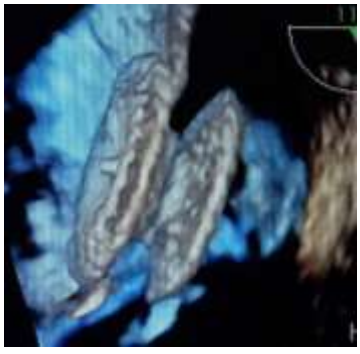
Closure device seen from the left atrium. The residual tissue of atrial septum is fixed between the two sides of the device (three-dimensional zoom mode acquisition).

What are the risk factors for erosion?

- Age ??
- Rims
  - Deficient aortic and/or superior rim (the rim to the dome of the left atrium)
  - Aortic rim absence in multiple views, Bald aorta
  - poor posterior rim consistency,
- Septal mal-alignment,
- Dynamic ASD .
- Movement of the device within the heart,
- Unnecessarily large or oversized occluder,
- Undersized occluder,

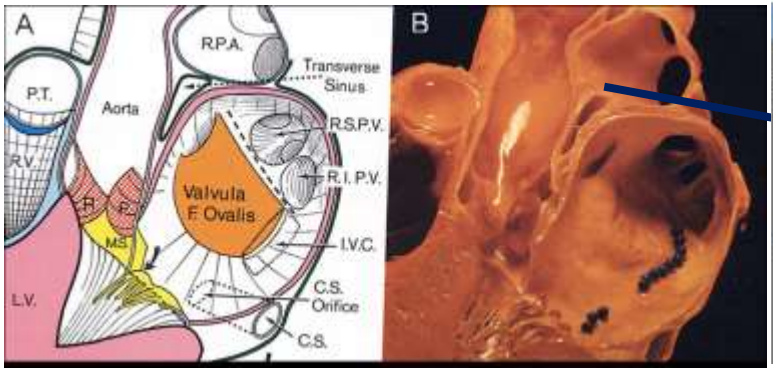
ASD Rims analysis

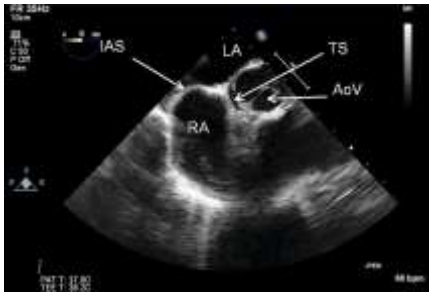




View of the ASD from the left atrium. The defect is in close proximity to the anterior and superior rim. Inset shows the ASO in place. The edges of the device are in contact with the anterior and superior rims. The aorta has been moved anteriorly to show the structures. RA, right atrium; LA, left atrium; Ao, aorta; PA, pulmonary artery.

Transverse sinus

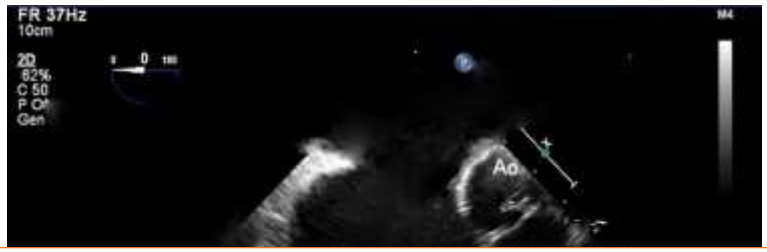




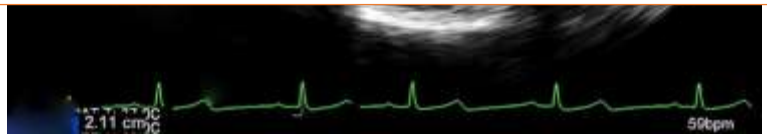
(A) Cartoon depicting the anatomic relations of the left atrial aspect of the atrial septum to the TS.

Poor posterior rim consistency,

Short-axis view on TEE showing the absent aortic rim (long arrow) along the ascending aorta (Ao) and thin posterior rim (short arrow). RA, right atrium; LA, left atrium.



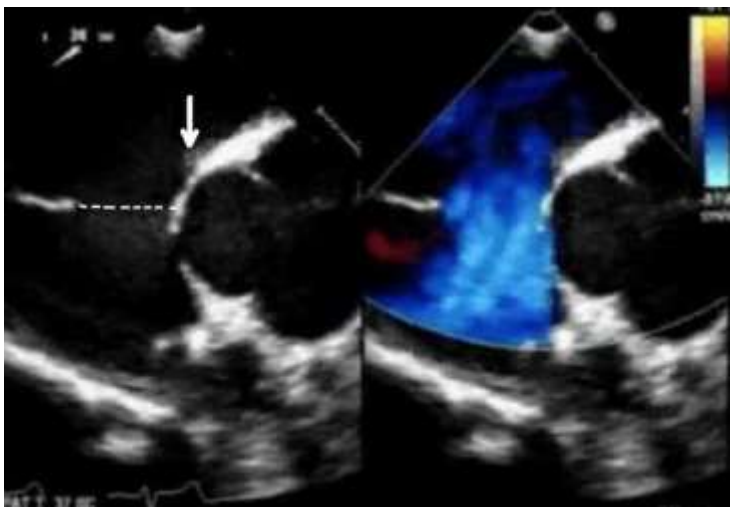
All patients who suffered from erosion had absent atrial septal rim in the four-chamber view



Four chamber view at zero degree with anterior aorta.
Note that there is no evidence of atrial septal rim.

This is termed as bald aorta

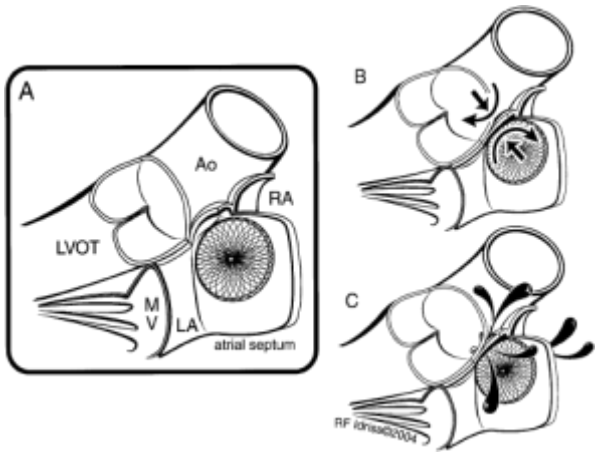
Mal-alignment



TEE showing short-axis aortic view: The dashed line from the septum primum to the idle of the non-coronary sinus depicts the typical location where the aortic rim (septum secundum) is usually present. In this patient, the short aortic rim (solid arrow) was mal-aligned left ward of the aortic sinus.

A device placed in mal-aligned septum will tend to be tilted and the edge of the device will dig into the atrial free wall/ aorta. This may result in erosion and sometime device embolization.

Mechanism of Erosion



A: ASO deployed in the ASD. Note the proximity of the free wall of the left and right atrium to the edge of the device.

B: With every cardiac cycle, the edge of the device acts like a seesaw that may result in bruising the atria and/or the aorta.

C: The device may ultimately erode the atrial wall and/or the aorta, causing hemodynamic compromise.

- The predominance of left atrial perforation with the ASO device may relate to the larger left atrial disk.
- All atrial perforations involved the roof of the atria (superior rim) and lead directly into the pericardium.
- Decreased right atrial cavity with elimination of the left-to-right atrial shunt could bring the device into contact with the atrial wall.
- So deficient superior or aortic rim may be associated with increased risk of an atrial perforation. Oversizing a device could increase this risk.

critically

During Valsalva maneuvers or other pressurizing Dynamic changes in the anatomic relationship between the device and surrounding cardiac structures

This issue could be of the utmost importance in people exposed to strenuous physical activity

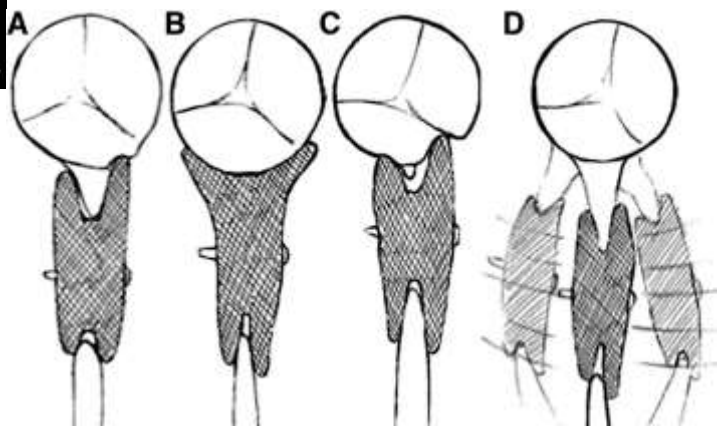
ECHOCARDIOGRAPHIC PREDICTORS OF EROSION AFTER PLACEMENT OF DEVICE

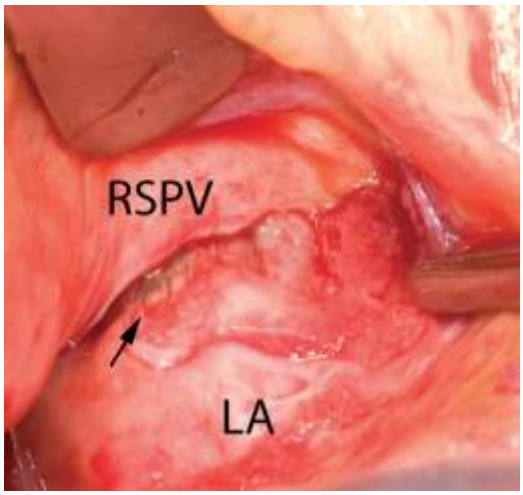
- Tenting of the atrial free wall into the TS . This is best visualized by TEE in short-axis view
- Wedging of the discs between the posterior wall and the aorta

- Pericardial effusion: After a large ASD closure,
  - The onset of effusion may initially manifest as widening of the TS. This should be an early warning sign of impending erosion especially if the device edges are seen tenting or across the atrial free wall

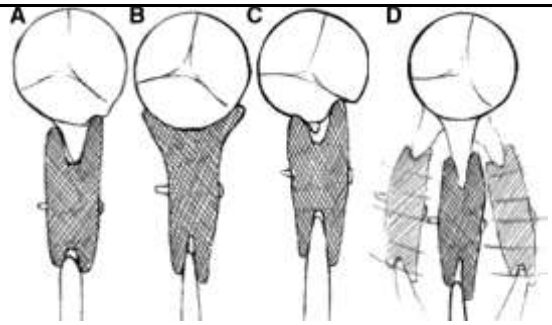
The highest risk of erosion
was found to be in patients with deficient aortic rim
and/or deficient superior rim or high ASD

Echocardiographic Predictors of Cardiac Erosion After Amplatzer Septal Occluder Placement

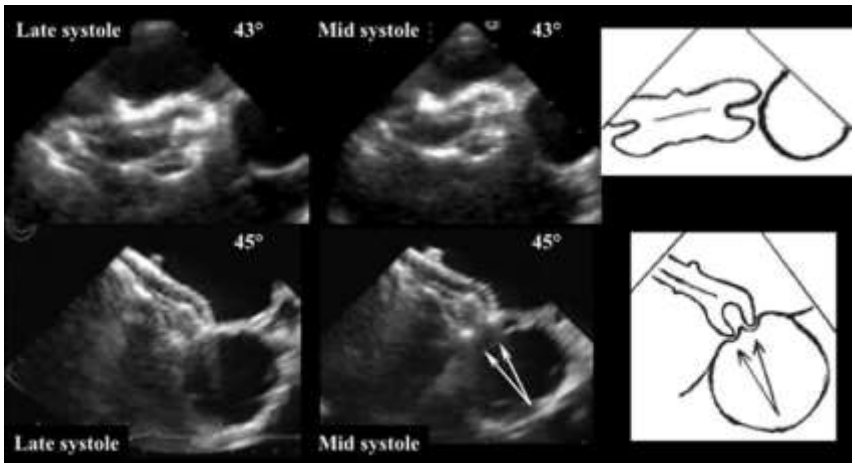




Photographic image showing the device eroding through the left atrial wall at the level of the right superior pulmonary vein during surgical exploration (Arrow indicates device erosion point)



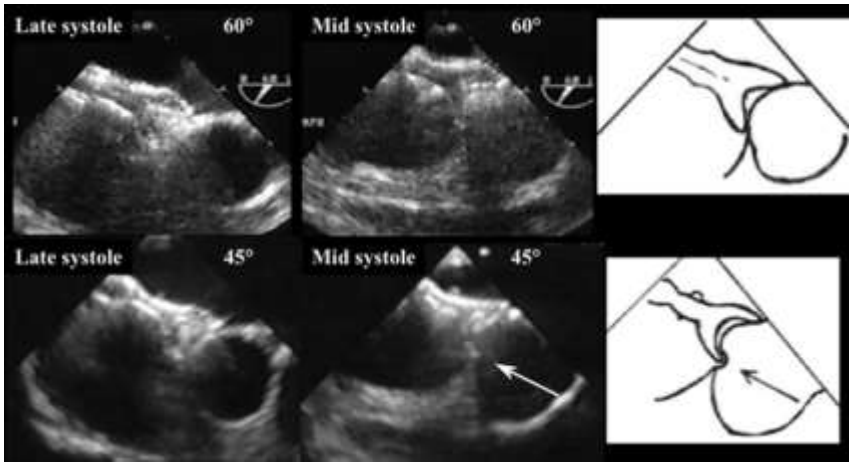
Potential Risk Factors for Erosion With Amplatzer Septal Occluder (A) Intermittent contact; (B) splaying; (C) protrusion; (D) motion.



Device edge by echocardiography in short-axis may show device tenting of the atrial free wall into the TS.

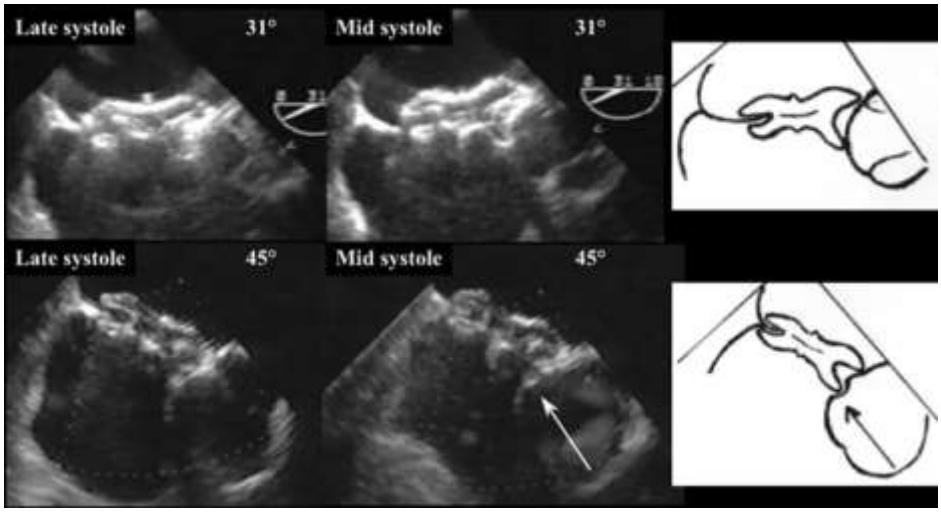
Immediately after deployment (upper photographs and diagram), the general device shape was bulky and the device shape on the aortic side was closed.

Six months after closure (lower photographs and diagram), the general device shape became more compact and the distant edges of the discs became elongated and both the right atrium and left atrium discs began to compress the atrial and aortic walls in the diastole to mid systole (arrows).



Immediately after deployment (upper photographs and diagram), the device shape on the aortic side was flared and the edges of the two flexible discs slide away from each other along the atrial walls behind the aorta in diastole to mid systole.

Twelve months after closure (lower photographs and diagram), although the device shape on the aortic side maintained a flare, the edges of the discs became closer to each other like a wrench and the right atrium disc began to compress the atrial and aortic walls in the diastole to mid systole (arrow).



Immediately after deployment (upper photographs and diagram), the device shape on the aortic side was flared and the edges of the two flexible discs slide away from each other along the atrial walls behind the aorta in early systole to mid systole.
Three months after closure (lower photographs and diagram), the discs lost their flexibility and developed a closed shape, and the right atrium disc started to compress the atrial and aortic walls in the diastole to mid systole (arrow).

Bloody pericardial effusion

Is a strong indictor to recommend surgical removal of device

Exrcise or valsalva manouver related erosion

- This hypothesis might suggest 2 precautionary initiatives:
  - 1)?? stress echocardiography in the routine assessment of patients after ASD closure device implantation to evaluate the appropriateness of the device positioning under dynamic conditions
  - 2) Greater restriction imposed during intense physical activity in ASD closure devices holders until this issue is finally elucidated.

Take home message (recommendations)

- Proper ASD sizing and avoid unnecessary oversizing
- Identify patients who may be at higher risk and will require closer follow-up
  - Patients with development of small pericardial effusion at 24-hr follow-up
  - Patients with deformation of the ASO at the aortic root (significant splaying of the device edges by the aorta)
  - Patients with high defects (minimal aortic and superior rims)
- Mandatory 24-hr follow-up in all patients

Take home message (recommendations)

- Educate patients about the risk and need for echocardiography with symptoms

- **The risk of erosion can be decreased significantly if a careful echocardiographic evaluation is performed and above findings ruled out**


thank
YOU
SO
much