

Post-Infarct VSD's The Patient's and Your Worst Nightmare

*Tips and Tricks to Get Through the Storm: What We
Have Learned*

Thomas J. Forbes, MD, FACC, FSCAI
Associate Professor Pediatrics-Wayne State University
Director Cardiac Catheterization Laboratories
Children's Hospital of Michigan
Detroit, Michigan

Disclosures

- Proctor for AGA Medical, Gore Corp, ,B. Braun Medical, NMT Medical
- Consultant for Siemens Medical,, Cordis Corp, B. Braun Medical, Gore Corp,, Cook Corp

CHM Cardiology

Incidence/Presentation of Post Infarct VSD's

- Thankfully extremely rare
 - We're NOT talking about congenital repair of VSD's
 - Occurs in 0.2%-2% of all acute MI's
 - Usually occurs 3-7 days after the initial event
 - As early as 24 hours and as late as 17 days
 - Presentation mimics sepsis
 - Low cardiac output with other organ compromise (liver and renal failure)
 - Shock
 - Severe respiratory distress
 - New onset murmur

CHM Cardiology

Incidence/Presentation of Post Infarct VSD's

Occurrence appears to be decreasing-though past 10 years has leveled off

Related to increased aggressiveness in performing early primary coronary intervention rather than relying on thrombolytic therapy

State of Michigan PI Rupture VSD's occur 6-8/year

CHM Cardiology

Experience

- Fewer than 900 total surgical and transcatheter reports have been published in the literature
 - Surgical Treatments primarily reported in the mid to late 1980's to early 2000
 - First Surgical repair by Denton Cooley in 1957
 - First Transcatheter approach described by Lock et al in 1998

Cooley D, et al. *Surgery* 1957;41:930-37
Landzberg MJ and Lock JE. *Semin Thorac Cardiovasc Surg* 1998;10:128-132

CHM Cardiology

Experience

Common belief that the majority of septal ruptures occur in 65 yo men with single vessel disease

In two large case series,*60% and **64% had single vessel disease respectively

* Deja MA, et al. *Euro J Cardio-Thor Surg* 2000;18:194-201
**Hill JD, et al. *J Thorac Cardiovasc Surg* 1975;70:440-46

CHM Cardiology

Outcomes

94-100% Mortality if VSD is medically treated

Surgical and transcatheter outcomes are similar, with < 30 day mortality ranging from 30-50%

CHM Cardiology

Survival Following Post-Infarct VSD

Who is at increased risk?

Clinical Presentation

PATHOPHYSIOLOGY AND NATURAL HISTORY
MYOCARDIAL INFARCTION

Postinfarction ventricular septal rupture: the importance of location of infarction and right ventricular function in determining survival

CARL A. MOORE, M.D., THOMAS W. NYGAARD, M.D., DONALD L. KAISER, D.Ph., ANN A. COOPER, R.N., AND ROBERT S. GIBSON, M.D.

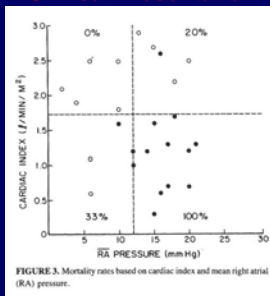
CHM Cardiology

Circulation 74, 1986 (1):45-55

Survival Following Post-Infarct VSD

Who is at increased risk?

Clinical Presentation



CHM Cardiology

Moore CA, et al. Circulation

Survival Following Post-Infarct VSD

Who is at increased risk?

Clinical Presentation

- Cardiac Index < 1.75 L/min/m²
- Mean Right Atrial Pressure > 12 mmHg
- Early Occurrence (< 6 days) of VSD rupture after onset of infarction
- Significant right ventricular and septal dysfunction

CHM Cardiology

Moore CA, et al. Circulation

Survival Following Post-Infarct VSD

Who is at increased risk?

Clinical Presentation

Correlates of Survival in Patients With Postinfarction Ventricular Septal Defect

Robin G. Cummings, MD, Robert Califf, MD, Robert N. Jones, MD, Keith A. Reimer, MD, PhD, Yi-Hong Kong, MD, and James E. Lowe, MD

Departments of Surgery, Cardiology, and Pathology, Duke University Medical Center, Durham, North Carolina.

CHM Cardiology

Ann Thorac Surg 1989;47:824-30

Survival Following Post-Infarct VSD

Who is at increased risk?

Clinical Presentation

Table 1. Effect of Time of Operation and Presence of Shock on Survival

Week After Myocardial Infarction	No. of Patients	No. in Shock	No. Surviving	Survival Rate (%)
1	8	6	2	25
2	6	5	3	50
3	3	2	2	67
4	7	2	5	71
>4	9	2	7	78

CHM Cardiology

Ann Thorac Surg 1989;47:824-30

Survival Following Post-Infarct VSD

Who is at increased risk?

Clinical Presentation

Rupture of the interventricular septum complicating acute myocardial infarction: A multicenter analysis of clinical findings and outcome

A. Christian Held, MD,¹ Patricia L. Cole, MD,² Barbara Lipton, MD,² Joel M. Gore, MD,¹ Elliott M. Antman, MD,² Judith S. Hochman, MD,² Jeanne Corrao, RN,¹ Robert J. Goldberg, PhD,¹ and Joseph S. Alpert, MD,¹ Worcester and Boston, Mass., and New York, N.Y.

CHM Cardiology

Amer Hrt Journal Nov 1988; 1330-1335.

Survival Following Post-Infarct VSD

Who is at increased risk?

Clinical Presentation

Table V. Hemodynamic findings in surgically treated patients with ventricular septal rupture complicating acute myocardial infarction

Hemodynamic pressures*	Survivors (n = 18)	Non-survivors (n = 19)	p value
RA	10 ± 6	15 ± 7	<0.05
PA systolic	49 ± 11	48 ± 13	NS
PA diastolic	21 ± 8	21 ± 6	NS
PA mean	31 ± 9	31 ± 8	NS
PCW	22 ± 11	21 ± 6	NS
Aortic systolic	108 ± 20	89 ± 15	NS
Aortic diastolic	64 ± 15	52 ± 21	NS
Left ventricle			
Systolic	108 ± 20	81 ± 19	<0.05
Diastolic	21 ± 6	22 ± 6	NS
Systemic blood flow index (L/min/m ²)	2.5 ± 0.7	2.4 ± 1.3	NS
Pulmonary to systemic flow ratio	3.0 ± 0.9	3.0 ± 1.7	NS

RA, Right atrium; PA, pulmonary artery; PCW, pulmonary capillary wedge.

*Pressures (mm Hg) presented as mean ± standard deviation.

CHM Cardiology

Amer Hrt Journal Nov 1988; 1330-1335.



Results of multiple regression analysis.^{2,3}

Variable	Variables in equation		
	Exp (B)	95% CI for Exp (B)	P
(a)			
Shock at surgery	5.74	2.07-15.97	0.0008
Log (MI-Op time)	0.03-0.64		0.002
(b)			
Shock at surgery	13.01	3.57-47.40	0.0001
Log (MI-VSD time)	0.17	0.05-0.64	0.008
CABG	2.72	0.84-8.79	0.09
Renal impairment (preop)	0.32	0.08-1.19	0.09
(c)			
Shock on admission	0.06	1.005-9.33	0.049
Denervation	0.02	1.60-22.64	0.008
Log (MI-VSD time)	0.15	0.04-0.49	0.002
Log (VSD-Op time)	0.32	0.11-0.95	0.04

* Multiple logistic regression results, dependent variable: 30-day mortality, the variables not in equation are not presented (score statistic probability >= 0.1), Exp (B), odds ratio; CI, confidence interval.
² (a) Shock at surgery and period of time from MI to surgery were included; (b) Period of time from MI to VSD and from VSD to surgery; (c) Shock at surgery was additionally substituted with two variables: shock on admission and haemodynamic deterioration in-between admission and surgery.

Survival Following Post-Infarct VSD

Who is at increased risk?

Clinical Presentation

- The presence of **shock** at time of intervention carries the highest risk for early mortality (up to 90%)
- Earlier onset of VSD rupture following index MI is a strong indicator for mortality (< 3 days)
- Inferior wall infarct, in the majority of studies, carries a high risk for mortality
- Requirement of performance of VSD closure within 12 days of VSD rupture

CHM Cardiology

Post Infarct VSD

Technique

- All patients placed under General Anesthesia
- All undergo peri-procedure TEE
 - Though ICE imaging helpful for the truly apical VSDs
- All should have placement of a separate arterial line (radial) for BP monitoring
- All should be typed and crossed
- Balloon sizing is not performed
- Vast majority performed via the RIJ route
- Perventricular advocated in certain apical VSDs

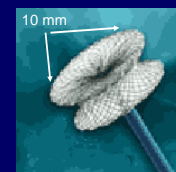
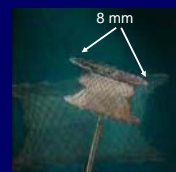
CHM Cardiology

Post Infarct VSD

Technique

Muscular VSD Occluder
 4-18 mm diameter
 4 mm "lip" off self-centering edge

Post-Infarct VSD Occluder
 16-26 mm diameter (24 mm in US)
 5 mm "lip" off self-centering edge



CHM Cardiology

Post Infarct VSD

Technique-Sizing the Defect

- In the stable patient who is > 14 days out from the appearance of the VSD
 - Take the major axis by echo/angio imaging
 - Choose a device that's 50% larger
 - Preference is to use the AGA muscular VSD occluder (4 to 18 mm diameter) or the post infarct VSD occluder (16-24 mm diameter).
 - AGA ASO occluder for larger than 24 mm defects (24-38 mm devices)

CHM Cardiology

Post Infarct VSD

Technique-Sizing the Defect

- In the unstable patient who is < 14 days out from the appearance of the VSD
 - Take the major axis by echo/angio imaging

CHM Cardiology

Post Infarct VSD

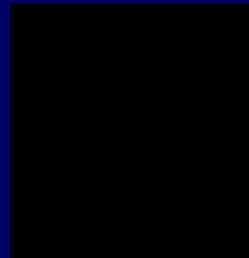
Technique-Sizing the Defect



CHM Cardiology

63 yo lady PI-VSD

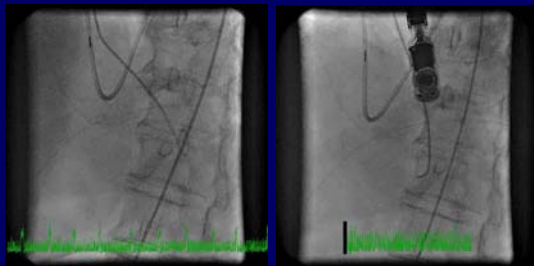
35 days Post MI-Stable



CHM Cardiology

Post Infarct VSD

Technique

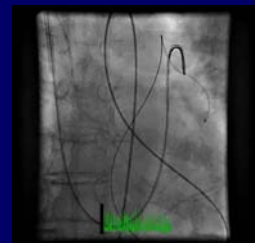
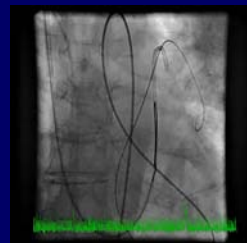


CHM Cardiology

Post Infarct VSD

Technique

Snare the 0.035" Glide wire and externalize it from the RIJ
This will be the same wire
to be used in advancing the delivery sheath across the
VSD



CHM Cardiology

Post Infarct VSD

Technique

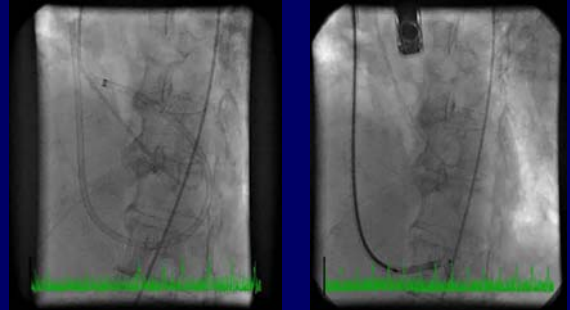
This is *not* a *pushing* procedure, this is a *pulling* procedure



CHM Cardiology

Post Infarct VSD

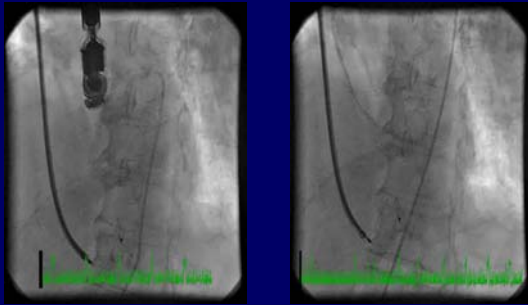
Technique



CHM Cardiology

Post Infarct VSD

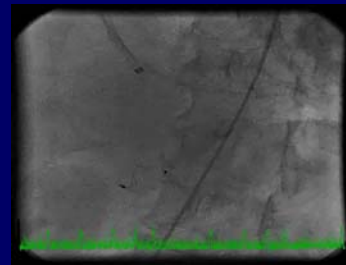
Technique



CHM Cardiology

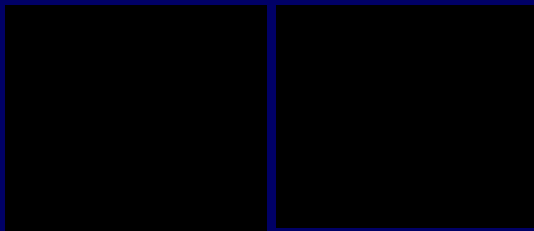
Post Infarct VSD

Technique



CHM Cardiology

Post 18 mm Muscular VSD Device



CHM Cardiology

Post Infarct VSD

Technique

- Be certain to check for AV valve regurgitation BEFORE and after device placement
 - Especially new onset TV regurgitation
 - Inferior/superior defects most susceptible
- Anti-coagulate immediately after the procedure

CHM Cardiology

Post Infarct VSD

Patient in "Shock"

RO is a 73 yo gentleman who suffered an MI and 3 days later noted to have a VSD

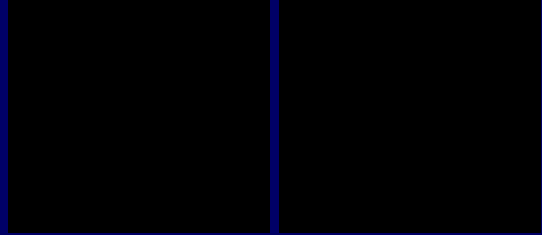
Required IABP initially

Extremely SOB and hypotensive, though not ventilated

Planned to take to cath lab for attempted device closure of VSD 7 days after VSD and 10 days after index MI

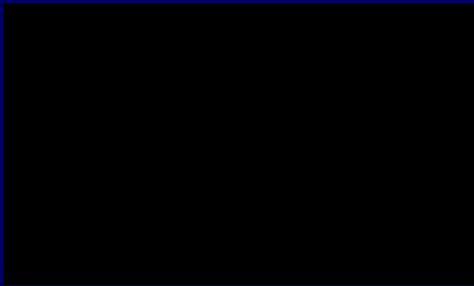
CHM Cardiology

RO Initial Studies



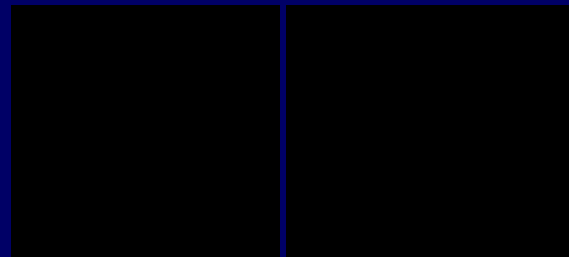
CHM Cardiology

RO Initial Studies



CHM Cardiology

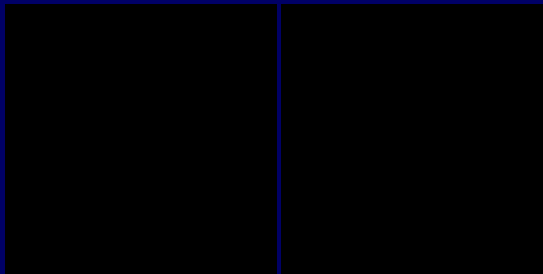
RO Initial Studies



Major axis 17.5 mm

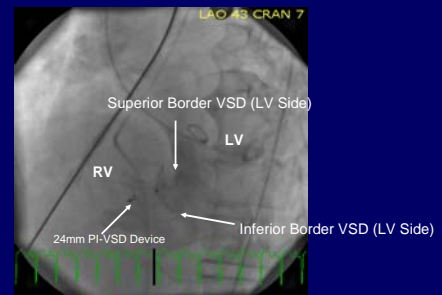
CHM Cardiology

First Attempt 24 mm PI-VSD Occluder



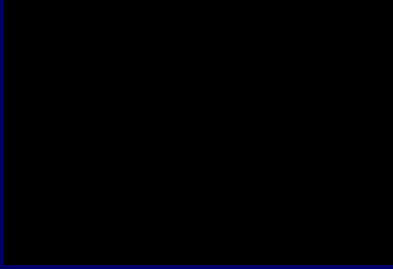
CHM Cardiology

First Attempt 24 mm PI-VSD Occluder



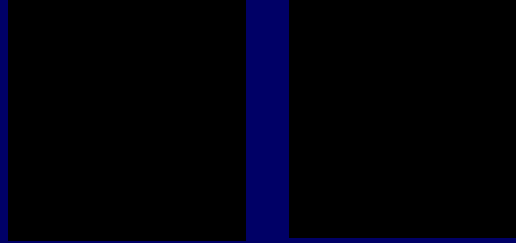
CHM Cardiology

Did well for 12 hours then
decompensated



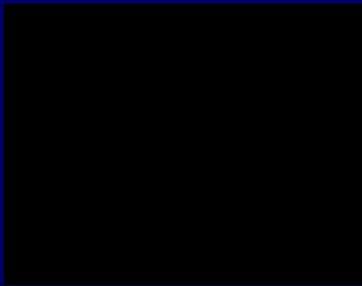
CHM Cardiology

PI-VSD Device Embolization to
RPA



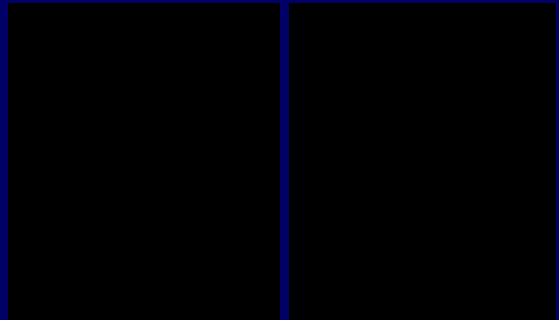
CHM Cardiology

Retrieval of 24 mm PI-VSD Device
From PA



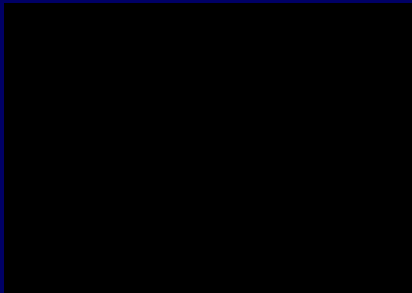
CHM Cardiology

Closure of VSD with 34 mm ASO



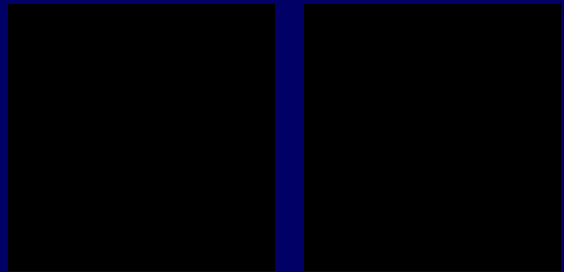
CHM Cardiology

Closure of VSD with 34 mm ASO



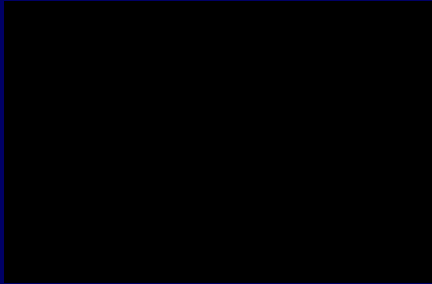
CHM Cardiology

Closure of VSD with 34 mm ASO



CHM Cardiology

Closure of VSD with 34 mm ASO



CHM Cardiology

The patient did well for 24 hours after the second procedure
Developed "septic" picture with new onset hypotension, WBC 30 K
Subsequently expired 6 days later

CHM Cardiology

Summary

Waiting is good if patient isn't in shock
Sheath is delivered by "pulling" not by "pushing"

No longer use stiff wire, use exchange
0.035" glide wire

Be certain to close the "true" VSD

Patient's condition determines size of device

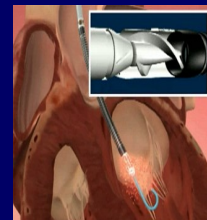
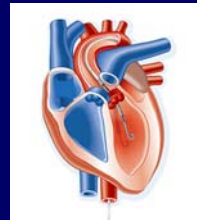
If > 14 days and stable, 50% larger than the major axis usually works

If < 14 days and/or unstable, use way way oversized device

CHM Cardiology

What *can* we do different?

We MUST get the patient out of Shock and buy some time



Impella 2.5

CHM Cardiology



CHM Cardiology



CHM Cardiology