POSTINFARCT VSD: OPERATE OR WAIT?

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DISCLOSURES

- Consultant Clearflow
- Research Grant Applied Medical
- Honoraria St-Jude Medical
- Honoraria Baxter
- Honoraria Johnson & Johnson
ACUTE POST-MI VENTRICULAR SEPTAL RUPTURE (VSRs)

• 2% in the pre-thrombolytic era
• Overall incidence decreasing
• Better control comorbidities
• With early reperfusion therapies
  -0.2% of pts with AMI (GUSTO)
MEDICAL VS SURGICAL TREATMENT

Ventricular Septal Rupture After STEMI

Class 1: Patients with STEMI complicated by the development of a VSR should be considered for urgent cardiac surgical repair, unless further support is considered futile because of the patient’s wishes or contraindications/unsuitability for further invasive care. (Level of Evidence: B)

Antman et al., J Am Coll Cardiol. 2004 Aug 4;44(3)
Surgical repair is required urgently, but there is no agreement on the optimal timing for surgery.

Early surgery is associated with:
- High mortality rate
- High risk of recurrent ventricular rupture

Delayed surgery allows:
- Easier septal repair in scarred tissue
- Carries the risk of rupture extension, tamponade and death while waiting.
- Mortality = high in all patients, higher in patients with inferobasal defects as opposed to anteroapical location.
ACUTE POST-MI VSRs

- Traditional Approach = Surgery
- Up to 50% mortality
- Postoperative residual shunt: 20%

**Preoperative determinants of success:**
* Extent of Tissue necrosis
* Right ventricular failure
* Multiple organ failure
* Age
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<th>Year</th>
<th>Author</th>
<th>No. pts</th>
<th>Mean delay VSD-surgery in days</th>
<th>Location of the VSD</th>
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DELAY SURGICAL INTERVENTION?
Results:

- N = 2,876 patients (men 56.5%, mean age = 68).
  - Prior CABG 215 (7.5%)
  - Prior percutaneous intervention 950 (33%)
  - Preop IABP 1,869 (65.0%).
- Surgical status = urgent in 1,007 pts (35%)
  emergent in 1,430 (49.7%).
- Concomitant CABG 63.9%

- Operative mortality = repair < 7 days: 54.1%
  repair > 7 days: 18.4%
Surgical Repair of Ventricular Septal Defect After Myocardial Infarction: Outcomes From The Society of Thoracic Surgeons National Database

Fig 3. Operative mortality rate is reported according to timing of myocardial infarction in relation to ventricular septal defect repair (p < 0.01 by univariate analysis).
OUTCOMES:

- Overall operative mortality = 42.9% (N=1,235).
- Nonlinear time trend with respect to operative mortality
- Highest operative mortality rate: VSD repair within 6 hours from MI.
Patients with multiple risk factors for operative death who are stable enough to delay an immediate operation may be better served by waiting several weeks before surgical repair.
POSTINFARCT VSD: WAIT AND DO WHAT??
IABP INSERTION

- INVASIVE MONITORING
- IABP
• Placement of IABP leads to immediate reduction in left-to-right shunt
• Increase in systemic cardiac output
• May allow hemodynamic stabilization of the patient prior to surgical VSD closure.

Fig. 2. Hemodynamic study before and after activation of the IABP. \( \% \) = oxygen saturation in the different cardiac chambers, \( CO \) = pulmonary cardiac output (measured by thermodilution method) NB this CO is probably underestimated due to the intrinsic limitations of the thermodilution method in case of intracardiac shunts [17] Eff CO = effective cardiac output, \( Qp/Qs \) = \((Sao_2 - Mvo_2)/(Pvo_2 - Pao_2)\), where \( Sao_2, Mvo_2, Pvo_2 \) and \( Pao_2 \) are systemic arterial, mixed venous, pulmonary venous and pulmonary arterial oxygen saturations. \( Mvo_2 \) is calculated by the Flamm formula, where \( = \frac{3(SVC \text{ O}_2 \text{ content}) + 1(IVC \text{ O}_2 \text{ content})}{4} \). SVC, superior vena cava; IVC, inferior vena cava. [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]
POSTINFEARCT VSD: WAIT AND DO WHAT??

- IABP
- INVASIVE MONITORING
- PERCUTANEOUS AMPLATZER CLOSURE?
There remain many important areas of uncertainty in the management of STEMI that offer opportunities for future research, one of which is:

- The development of percutaneous techniques for managing ventricular septal defects may permit avoidance or delay of surgical repair, while providing potentially life-saving therapy to these very high-risk patients.
PERCUTANEOUS DEVICES

- CardioSEAL® and STARFlex®

- AMPLATZER® mVSD-PI Occluders

Oversizing
(4 mm to 10 mm more than VSR size at echo)
PERCUTANEOUS CLOSURE
IN ALL LIKENESS, PRESENT AND FUTURE ATTEMPTS TO UTILIZE VARIOUS PERCUTANEOUS SEPTAL OCCLUDERS AS A SUBSTITUTE FOR THE PATCHING OF RUPTURES ARE PRONE TO FAIL BECAUSE NECROTIC SEPTAL TISSUE HAS VERY LITTLE IN COMMON WITH HEALTHY SEPTAL TISSUE...

On Topaz, Am J Cardiology, August 2003
PERCUTANEOUS CLOSURE

• TRANSCATHETER MANAGEMENT:
  • Based on congenital muscular VSDs
  • Technique offered initially to
    • PATIENTS at excessive risk for surgery
      • Medical comorbidities
      • Location of the VSD
      • Presence of profound RV and/or LV dysfunction
      • Shock
      • MOF
  • Patients with residual VSD after surgery
Few centers around the world have been successful in repairing post-AMI VSDs percutaneously.

Approach improving survival if the VSD is amenable to percutaneous repair when:

1. VSD diameter $\leq 2.5$ cm,
2. Adequate septal margin for device anchoring,
3. Adequately thick myocardial free wall,
4. Central rather than apical septal position
5. No proximity to the aortic valve

Does the placement of an Amplatzer septal occluder device confer benefit in patients with a post-infarction ventricular septal defect?

- Mortality rate and repair of a post-infarction VSD = amongst highest cardiac surgical procedures
- Amplatzer septal occluder device = complete closure of the defect
- Acting as a bridge to surgical repair following a period of stabilization + patient optimization to best possible outcome in fatal condition

Percutaneous Ventricular Septal Defect Closure With Amplatzer Devices Resulting in Severe Tricuspid Regurgitation

• Percutaneous closure with Amplatzer septal occluder device attempted on three patients who developed a VSD after myocardial infarction.
• In all three cases, damage to the tricuspid leaflet was noted post-procedure.
• Accompanying severe tricuspid regurgitation led to right ventricular failure, even in the patients where the VSD was considered successfully occluded.
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POSTINFARCT VSD: WAIT AND DO WHAT??

- IABP
- INVASIVE MONITORING
- VENTRICULAR ASSISTANCE?
  - IMPELLA 5.0
  - TANDEM HEART
  - BIVENTRICULAR ASSISTANCE
  - TAH
  - HEMOPUMP
Since 2005, in all cases of posterior VSD with early cardiogenic shock, the Impella Recover 5.0 system was used together with traditional IABP, in order to stabilize the patient and delay surgery.

Independent predictors of 30-day mortality:
1. Advanced age,
2. Critical status,
3. Use of catecholamines,
4. Early repair
5. Posterior rupture

Initial experience using the Impella Recover 5.0 in cases of cardiogenic shock due to posterior ventricular septal defect

• Conservative approach = feasible and safe way to improve hemodynamic conditions and delay surgery.

• Further clinical experience needed to confirm these early results.
While Pitsis and colleagues report successful bridging of a patient to surgery on left ventricular support, high right-to-left shunting has been described to result in hypoxic brain damage in another patient placed on left ventricular assist device after suffering from postinfarction ventricular septal rupture, suggesting biventricular support to be implemented when considering mechanical assistance.
STAGED APPROACH:
Hemodynamics improved immediately after:
• pVAD placement 8 preop 3 post repair
• pVAD support for 7±3 days and surgical VSD repair.
Total pre- and post-surgical pVAD support was 14±4 days.
• All eight preop pVAD survived 30 days postoperatively.
• 6 months postsurgery overall survival rate = 75%.

Mortality is still very high in Surgical Repair of VSDs within the first days after AMI in patients with:
1. Severe refractory cardiogenic shock
2. Posterior VSD
At arrival, emergency venoarterial ECMO was instituted through the femoral vessels. Patient’s condition was allowed to stabilize for 24 hours. Patients underwent surgery for possible repair and device support. Because of extensive myocardial damage and poor function, the decision was made intraoperatively for TAH-t placement.
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Postinfarction Ventricular Septal Defects: Towards a New Treatment Algorithm?

Simon Maltais, MD, MS, Reda Ibrahim, MD, Arsène-Joseph Basmadjian, MD, Michel Carrier, MD, Denis Bouchard, MD, Raymond Cartier, MD, Philippe Demers, MD, Martin Ladouceur, MS, Michel Pellerin, MD, and Louis P. Perrault, MD, PhD

Cardiac Surgery and Cardiology Department, Montreal Heart Institute and Université de Montréal, and Biostatistics Department, McGill University Health Centre, Montreal, Quebec, Canada
PROPOSED APPROACH 2015

VSD

- Unstable
- Standard risk ± 20%
  - Operate Patch Closure
  - Recurrence

- Stable
  - IABP
    - High Risk
      - Shock
      - Anuria
      - Posterior
      - RV/LV Failure
      - ASSISTANCE
      - WAIT > 7d
  - Inoperable
    - Percutaneous Closure
    - OR
    - > 7-14 d ?

WAIT > 7d ?
CONCLUSIONS

- Wait and do nothing with the VSD = RARE
- IABP in all patients
- Wait with IABP? = not enough for VSD>20 mm
- Close percutaneous w bridge to surgery = possible but unreliable despite technical success
- Operate w patch closure, exclusion technique if no profound shock, anuria, severe RV failure and more than 6 hours after MI (>2 days?)
- Ventricular support for 7 days for emergent, severe shock, RV failure, posterior VSD