Minimally Invasive Mitral Valve Repair/Replacement (MVR) Procedure

TECHNIQUES FOR MINIMALLY INVASIVE MITRAL VALVE REPAIR/REPLACEMENT

Joseph Lamelas, MD

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The minimally invasive MVR procedure is a minimally invasive direct vision approach for repairing or replacing the mitral valves through the same small incision. The procedure is performed under direct vision through a right lateral mini-thoracotomy and achieved by creating a 5-6 cm incision in the 4th-5th intercostal space (ICS) and using a soft tissue retractor and rib spreader to improve visibility. Arterial and venous cannulation are usually performed through the femoral/axillary artery and femoral vein.

Potential Benefits of Minimally Invasive MVR

- Reduced trauma and pain
- Decreased blood loss
- Decreased wound infection
- Decreased transfusions
- Reduced recovery time
- Better cosmetic results and improved patient satisfaction
- No difference in morbidity and mortality
- Facilitates redo surgery
- Avoids sternal wound complications
- Faster recovery

NOTE: The views and techniques expressed herein and in the training are the views of Dr. Joseph Lamelas. This information is provided as a general resource, but is not intended to constitute medical advice or in any way replace the independent medical judgment of a trained and licensed physician with respect to any individual patient needs or circumstances. Please see the Instructions for Use for all product indications, contraindications, precautions and adverse events.

1. PATIENT SELECTION
The following may be considered exclusion criteria for Mitral Valve Minimally Invasive Cardiac Surgery.
• Inability to cannulate femoral and axillary vessels due to severe Peripheral Vascular Disease (PVD), central aortic cannulation may be an option.
• Alternative approach: Patients with prior coronary or valvular surgery can be performed with the heart fibrillating.

2. PATIENT POSITIONING
• Place roll behind the tip of the right scapula
• Position right arm at a 45° angle off to the side of the bed

3. CANNULATION
A longitudinal incision is made above the inguinal skin fold. Limited dissection and exposure of the anterior aspect of the femoral vessels is recommended. Use a Seldinger technique to perform femoral artery and vein cannulation. If the artery is small consideration should be given to obtaining proximal and distal control of the artery and performing an arteriotomy and direct cannulation.
• If the left femoral artery is extremely calcified, explore the opposite side or expose and cannulate the right axillary artery utilizing a Seldinger technique. When cannulating the left femoral artery a 16 to 18 French arterial cannula is used.
• Insert the 25 French venous cannula from the left femoral vein into the superior vena cava (SVC) using transesophageal echocardiography (TEE) guidance.
• Verify wire location in the SVC prior to passing the cannula (very important). If there is resistance while passing the cannula, immediately abandon this path and insert the cannula via the opposite vein.
• If there is resistance during insertion of the wires or cannula, do not hesitate to utilize fluoroscopy or intraoperative angiography to assess obstruction.

4. INCISION AND EXPOSURE
• Perform a 5-6 cm chest incision in the 4th or 5th ICS, lateral to the anterior axillary line (in FEMALE patients, a plastic drape is utilized to retract the breast superiorly and to the left. Enter the skin through the right inframammary crease and track up 2 interspaces prior to entering the chest cavity.)
4. INCISION AND EXPOSURE...CONTINUED

- Use a soft tissue retractor and rib retractor to obtain further exposure.

- A chest tube incision is made inferior to the chest incision. This incision is also considered a utility port during the procedure for the following steps below.
  - One cardiotomy suction is used and enters the incision field via the utility port. 
    Note: Two suction tubes are passed for redo fibrillating procedures.
  - A diaphragmatic suture is placed and tied on the tendinous portion of the diaphragm.
    Note: This procedure step is optional when the diaphragm is not obstructive.

- Pericardial tacking suture on right lower aspect of the pericardium (above the inferior vena cava)
  - Open the pericardium approximately 2-3 cm above the phrenic nerve.
  - Place a pericardial retraction suture on the lower most portion of the pericardium and exit through the chest tube incision (as previously described).
  - Place additional pericardial sutures at the level of the right pulmonary veins, SVC, and upper aspect of the pericardium. Additional sutures can be placed to further facilitate exposure. Exit the retraction suture at the superior pulmonary vein aspect of the pericardium through the skin at the level of the interspace opened. Use a crochet hook to pull this suture out of the chest wall.

- A minimum of 4 pericardial sutures is required. Additional sutures are placed to further retract towards the incision.

5. CARDIOPLEGIA, CPB & CROSS-CLAMPING

- Place a purse-string suture in the right atrium at the junction of its middle and lower third horizontally and its midpoint vertically. Insert a retrograde cardioplegia (CP) cannula into the coronary sinus via the purse string using TEE guidance. There should be backflow of dark venous blood from the CP cannula and a ventricularized wave pattern to additionally confirm placement. Note: A third method of verification is to visualize dark blood returning from the aortic root into the left ventricle when delivering CP.

- Institute cardiopulmonary bypass. If single lumen intubation is utilized, one may chose to institute CPB prior to opening the pericardium to obtain better visualization.

- Use electrocautery and blunt dissection to develop a plane between the inferior aspect of the aorta and the superior aspect of the right branch of the pulmonary artery.

- Cross-clamp the ascending aorta directly through the incision using a flexible cross-clamp in the previously developed plane.

- Give an initial dose of antegrade CP, then retrograde CP thereafter.

- Additional doses of antegrade CP should be given throughout the procedure. If a CP needle is not left in the aorta for the entire procedure, care should be taken to ensure that the CP needle is inserted directly into the lumen of the aorta (not wall) while administering additional doses.
6. ATRIOTOMY

- Perform a left lateral atriotomy via Waterson’s groove to expose the mitral valve.
- An atrial lift retractor blade is initially placed into the left atrium and positioned underneath the septum. The blade is manipulated until one obtains the best visualization of the mitral valve.
- The post of the atrial lift retractor is then inserted through a separate stab wound. If possible, care is taken to avoid injury to the right mammary artery and vein.

7. VALVE REPAIR OR REPLACEMENT

- Inspect the valve and perform repair or replacement as needed.
- If repairing the valve, place all of the annular sutures prior to performing your valve repair technique of choice. This will aid exposure and visualization of the valve and infravalvular apparatus.
- Further visualization of the infravalvular apparatus is aided with a mitral collar.

8. CLOSING

Optional: Prior to closing the atriotomy, place a cardiotomy suction through the valve to aid in de-airing.

- Close the atriotomy using a running suture line.
- Place patient in steep Trendelenburg position and inflate the lungs.
- Remove the cross-clamp.
- Place a de-airing needle in the root of the aorta and de-air the heart in the usual fashion, using TEE guidance. Shake patient or compress the chest if needed for de-airing. Avoid direct manipulation of the heart due to potential of injury. In redo cases, it is extremely important to have an aortic root vent to ensure adequate de-airing.
- Place one right ventricular pacing wire on the inferior wall of the right ventricle. The atrial pacing wire is optional.
- Wean patient from cardiopulmonary bypass.
- After 50% of protamine is given, remove femoral venous cannula. If inserted percutaneously, place a large U-stitch around the venous cannula insertion site prior to removal. After removal, apply pressure for one-half hour. Recommendation: This suture should NOT be removed for 3 days.
- After protamine is completely given, remove arterial cannula.
- Usually only one right-angled chest tube is placed in the right pleural space in the costophrenic angle. If a pericardial drainage tube is required, place a Blake® chest tube through the oblique sinus. Leave the pericardium open for improved drainage.
- Give a bolus of local anesthesia into the ICS. Recommendation: 25 cc of 0.25% Bupivacaine without epinephrine.

9. END OF PROCEDURE

- Use one pericostal suture to approximate the ribs.
- Use an On-Q PainBuster® system with both catheters placed in the pleural space.
HOW DO I BEGIN?

Medtronic offers peer-to-peer education for those interested in learning how to do a Minimally Invasive MVR procedure. Please contact your CardioVascular sales representative for more information.

**Instruments and Disposables* as typically used by Dr. Joseph Lamelas**

**Medtronic Prosthetic Valves** – Mosaic® Bioprosthesis, Hancock® II Bioprosthesis  
**Medtronic Repair Products** – CG Future® Ring or CG Future® Band, Profile 3D® Annuloplasty Ring, Contour 3D® Annuloplasty Ring  
**Reusable Instruments:**  
- Miami Instruments® Minimally Invasive Rib Retractor System  
- Geister® Cygnet 66 mm Flexible Aortic Cross Clamp  
- Minimally Invasive Scissors, Curved  
- Minimally Invasive Scissors, 30°  
- Minimally Invasive Needle Drivers, Curved Locking (Qty. x 2)  
- Minimally Invasive Forceps Straight, Double Action (Qty. x 2)  
- Forceps Narrow Straight, Double Action  
- Minimally Invasive Hook (Qty. x 2)  
- Geister® Iron Assistant

**Disposable Supplies**  
- Miami Instruments® Joseph Lamelas Atrial Lift System™  
- Miami Instruments® Joseph Lamelas Knot Pusher™  
- Minimally Invasive Aortic Clamp Inserts  
- Alexis® Soft Tissue Retractor, Medium/Small Cannulation  
- Medtronic Bio-Medicus® Femoral Venous Cannula, 25 Fr  
- Medtronic Bio-Medicus® Femoral Venous Multi-Stage Cannula, 25 Fr  
- Medtronic Bio-Medicus® Femoral Arterial Cannula 15 Fr, 17 Fr, 19 Fr, 21 Fr  
- Retrograde Cardiopleiga Cannula  
- Angio Cath, 14 gauge  
- Red Reubbers, 10 Fr  
- PICV Dilator Set  
- Peripheral Guide Wire  
- On-Q® Pain Pump System  

* The instruments/disposables listed are in addition to essential instruments necessary to perform surgery.

Over 35 years of scientific innovation, resulting in more options for minimally invasive heart valve repair and replacement.
Mosaic® Porcine Bioprosthesis

**Indications:** For the replacement of malfunctioning native or prosthetic aortic and/or mitral heart valves. **Contraindications:** None known.

**Warnings/Precautions/Adverse Events:** Accelerated deterioration due to calcific degeneration of bioprosthesis may occur in: children, adolescents, young adults, and patients with altered calcium metabolism (e.g., chronic renal failure, hyperparathyroidism). Adverse events can include: angina, cardiac arrhythmia, cardiac dysrhythmias, death, endocarditis, heart failure, hemolysis, hemolytic anemia, hemorrhage, transvalvular or paravalvular leak, myocardial infarction, nonstructural dysfunction, stroke, structural deterioration, thromboembolism, or valve thrombosis. For additional information, please refer to the Instructions For Use provided with the product. **CAUTION:** Federal law (USA) restricts this device to sale by or on the order of a physician.

CG Future® Annuloplasty System, Profile 3D® Annuloplasty System

**Indications:** This device is indicated for the reconstruction and/or remodeling of pathological mitral valves. Valvular insufficiency and/or stenosis may be corrected by appropriate repair and annular remodeling. **Contraindications:** Heavily calcified valves, valvular retraction with severely reduced mobility, active bacterial endocarditis. **Warnings/Precautions/Adverse Events:** Only physicians who have received proper training in valve repair should use this device. Adverse events can include: thromboembolic events, dehiscence, hemolysis, stenosis, residual incompetence, heart block, endocarditis, systolic anterior motion, left ventricular outflow tract obstruction, anticoagulant-related bleeding or hemorrhage. For additional information please refer to the Instructions for Use provided with the product or contact your local Medtronic representative. For additional information please refer to the Instructions For Use provided with the product or contact your local Medtronic representative. **CAUTION:** Federal law (USA) restricts this device to sale by or on the order of a physician.

Miami Instruments® Joseph Lamelas Atrial Lift System™

**Indications:** This device is designed for single patient use only. Do not reuse, reprocess, or resterilize this product. Reuse, reprocessing, or resterilization may compromise the structural integrity of the device and/or create a risk of contamination of the device, which could result in patient injury, illness, or death. Do not use if package or product is damaged. It is the responsibility of the user to dispose of the device in accordance with local regulations and hospital procedures. For additional information please refer to the Instructions for Use provided with the product or contact your local Medtronic representative. For customer service, contact your Medtronic sales representative or Medtronic Customer Service 1-800-328-2518. **CAUTION:** Federal law (USA) restricts this device to sale by or on the order of a physician.

Miami Instruments® Joseph Lamelas Knot Pusher™

**Indications:** This device is intended for use to retract the atrial wall during limited access cardiac surgical procedures. **Contraindications:** None known. **Warnings and Precautions:** This device is designed for single patient use only. Do not reuse, reprocess, or resterilize this product. Reuse, reprocessing, or resterilization may compromise the structural integrity of the device and/or create a risk of contamination of the device, which could result in patient injury, illness, or death. Do not use if package or product is damaged. It is the responsibility of the user to dispose of the device in accordance with local regulations and hospital procedures. For additional information please refer to the Instructions for Use provided with the product or contact your local Medtronic representative. For customer service, contact your Medtronic sales representative or Medtronic Customer Service 1-800-328-2518. **CAUTION:** Federal law (USA) restricts this device to sale by or on the order of a physician.

Bio-Medics® Femoral Arterial Cannulae

**Bio-Medics® Multi Stage Femoral Venous Cannulae**

**Indications:** This percutaneous cannula is for use by trained physicians only, to cannulate vessels, perfuse vessels or organs in a patient for cardiopulmonary bypass circulation. Standard surgical or percutaneous insertion techniques can be employed. This product is intended for use up to six hours or less. **Contraindications:** Alone, this cannula is not a medical treatment device. Selection of patient as a candidate for such procedures is the physicians’ responsibility. The outcome is dependent on many variables including patient pathology, surgical procedure, and perfusion procedures. Do not use if the patient has severe peripheral atherosclerosis or severe arterial dissection. This device is not intended for use except as indicated. Care and caution should be taken to avoid damage to vessels and cardiac tissue during cannulation or other cardiac surgery procedures. For a listing of indications, contraindications, precautions and warnings, please refer to the Instructions for Use. **CAUTION:** Federal law (USA) restricts this device to sale by or on the order of a physician.

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