HEART FAILURE SURGERY OR SVR

Shahid Mahmud Malik (FRCS)

Ittefaq Hospital, Lahore – Pakistan.

ABSTRACT

Surgical Ventricular Restoration (SVR) is a surgical procedure to treat congestive heart failure caused by myocardial infarction[4]. Following a heart attack, scar tissue or an aneurysm may develop resulting in an enlarged rounded heart. This may lead to congestive heart failure (CHF)[2]. The goal of the SVR is to restore the heart to a more normal size and shape, thereby improving function[7].

METHOD: Retrospective analysis of 42 surgeries between 1995 and 2010 was carried out. The records of 36 males and 06 females were studied. The methodology involved from left ventricular scar excision and primary suturing to ventricular restoration using a patch with LV volume measurement.

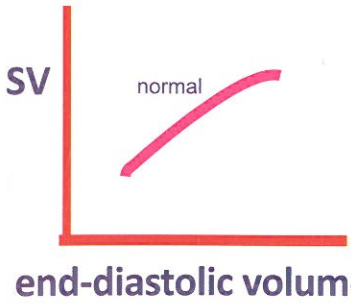
RESULTS: The restoration of the LV resulted in improvement of the ejection fraction.

CONCLUSIONS: After ventricular reduction surgery with improvement in EF, the symptoms of heart failure disappeared or improved significantly.

Key Words: *LV aneurysm, heart failure, ventricular reduction, ventricular remodelling.*

Address for Correspondence:
162-S, Street no 8,
Phase II, DHA,
Lahore.

The SVR procedure is usually performed in conjunction with coronary artery bypass grafting (CABG) to ensure optimal blood supply to the heart[14]. Some patients will also need valve repair or replacement.



Graph-1: Relationship between LV end diastolic volume and stroke volume in the normal heart.

Because the ventricle is struggling to eject the blood contained within, the ventricle dilates, increasing its end-diastolic volume, which is the volume of the ventricle just before it starts to contract. Normally, of course, the increased end-diastolic volume leads via the Frank-Starling Mechanism to a more powerful contraction and thus an increased stroke volume. But here, the ventricle is weak, so that this compensatory mechanism is blunted. Graph-1 shows stroke volume as a function of end-diastolic volume for the normal heart. What happens to this relationship in heart failure?

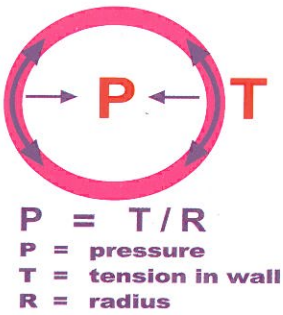


fig-1: Law of Laplace.

As systolic heart failure progresses, the end-diastolic volume increases. This makes matters worse for the struggling ventricle. Observe in the fig-1 how the Law of Laplace relates the pressure in a ventricle to the radius of the ventricle and the tension in the wall of the ventricle. The law specifies that a dilated ventricle requires more tension in the wall to generate the same pressure. In other words, the poor, failing ventricle must work harder to accomplish the same thing.

PREOPERATIVE ASSESSMENT

These include:

A chest X-ray, ECG, Echocardiogram: to provide information about the pumping ability of heart and how well the valves are functioning.

A recent cardiac catheterization.

Routine lab work including CBC, LFTs, Renal profile and Coagulation profile.

Magnetic Resonance Image: A magnetic imaging to create a picture of the heart and its structures, which helps guide surgical decision making.

If the patient has an AICD or pacemaker a special cardiac CT may be obtained.

OTHER NAMES FOR SVR

- End ventricular circular patch-plasty repair
- Dor procedure (to credit Vincent Dor, MD who authored many articles on the procedure and began performing in the early 1980's)
- Surgical ventricular restoration
- Left ventricular infarct exclusion surgery
- Left ventricular reconstructive surgery
- Left ventricular aneurysm reconstruction

HISTORY

1958: Denton Cooley MD, from Houston Texas, published the first report of a patient undergoing left ventricular aneurysmectomy supported by cardiopulmonary bypass. The procedure he described was excising all non-functional left ventricular tissue and closing the ventricle.
1984: Adib Jatene MD, San Paulo, Brazil presented his technique of reconstructing the left ventricle. Jatene believed that looking at the entire disease and proper reconstruction of the left ventricle would change results. He believed that the septum was involved in the disease and should be treated.
1985: Vincent Dor MD, Nice France believed that akinetic and dyskinetic tissue should be treated in the same manner. He introduced the importance of recreating the ventricular apex in improving ventricular function.
1998: Vincent Dor MD, published multiple papers on his tremendous experience with ventricle restoration. He applied his technique to patients with only akinetic scar increasing the number of patients that could be treated. Dor introduced the use of a balloon of a known volume to ensure the ventricle that was created was not too small.
2001: Gerald Buckberg MD; Los Angeles, California, reconfirmed the importance of restoring normal ventricular size, shape and orientation. He noted it was important to look at left ventricular shape and volume rather than how than how the blood was ejected. He also emphasized the importance of the apex.

SURGICAL VENTRICULAR RESTORATION

Over 40 years, the most important lesson described by all was that the heart and ventricle are complex structures and it is impossible to "imagine" the elliptical ventricle consistently without the use of a guide. The introduction of the pre-shaped Mannequin eliminates the guesswork of the procedure and results in optimal ventricular size, shape, and orientation as described by Di Donato and Menicanti.
We have devised a local solution for measuring the left ventricular volume prior to resection of the scarred ventricle. This local solution is the use of a large Foley's catheter which functions in the same manner as the mannequin.

SVR AND BATISTA PROCEDURE

SVR specifically removes scar tissue,
Batista operation only removes lateral wall tissue leaving behind the scar tissue. The results of Batista are inconsistent and generally poor. Batista is not the procedure for heart failure.

OPTIONS AVAILABLE FOR HEART FAILURE TREATMENT

Heart Transplant: Not practical in Pakistan.
Medications: The drawbacks of continued prolonged heart failure treatment regimens are: Complex dosing regimens which are difficult to follow. Medication treats the symptoms not the shape of the heart.

Biventricular Pacing: This is only for patients with specific electrical disturbances. The devices are costly and do not alter or restore the size or shape of the ventricle.
Left Ventricular Assist Device: Used for end-stage patients. Usually serve as a bridge to transplant, but may be used as an alternative for some patients.
Coronary Artery Bypass Grafting[14]: Done to improve blood supply and may improve function. Does nothing to address the changes caused by the heart attack. SVR is usually done in conjunction with CABG

Valve Repair/Replacement: Reduces/eliminates amount of leakage and may improve function. May improve shape/size over time.

SURGERY: After primary median sternotomy and opening of the pericardium a careful initial assessment of the heart is made (photo-1). If concomitant bypass is planned then the target coronaries are identified and number of conduits planned. If left internal mammary artery is required then it is harvested at this stage. If there is a need to repair or replace the mitral valve, then the mode of venous cannulation is selected. After full heparinization, aorto- venous cannulation is performed and on full cardiopulmonary bypass, another assessment is carried out. Initially a small incision is made in the ventricle to find the exact location of scarred or dead muscle. This incision can then be extended until the edge of the scar both upwards and downwards (photo-2). A single or double row of row of sutures is placed at the edge of the scar to delineate the dead from viable muscle. A Fontan or a purse stitch is placed at the edge of the viable muscle to reduce its circumference (photo-3). A size 1 polypropylene suture can be used for this step.

The Law of Laplace is the basis on which this left ventricular reduction operation is based. However, so as to safeguard against over reduction, Dr. Menicanti and Dr. Donato developed the TRISVR procedure which led to the development of the "Mannequin". This mannequin ensures a more normal short/long axis ratio and gives a correct position of the new ventricular shape.

As this measuring prosthesis is very expensive and not available in our country, we devised our own method of duplicating this step (photo-4). This local measuring device is the largest Foley's catheter which can accommodate 80-85cc of volume.

If the procedure involves performing an additional procedure like CABG and/or mitral valve repair or replacement, it is performed at this stage. The left ventricular reduction is completed after the additional procedure is carried out (photo-5).

After the additional procedure is completed, a piece of double velour knitted gel impregnated Dacron is cut to size after insertion of the measuring device and pulling tight of the Fontan stitch, thereby reducing the left ventricle in a controlled fashion (photo-6). The patient is re-warmed and weaned from cardiopulmonary bypass in the usual manner. Inotropes and or Intra Aortic Balloon pump may be required depending on the individual case.

OUR EXPERIENCE:

Retrospective analysis of surgeries performed by a single surgeon from 1995-2010 is presented here. The data was collected from two different hospitals where the surgeon operates. The data of a total of 42 patients were retrieved.

There were 36 males and 06 females.

Age range 43-67yrs (mean 57yrs).

Pre operative EF 15 – 20%.

All patients had a history of myocardial infarction six to forty eight months preceding the operation.

Four patients were not accepted as the RV was severely dysfunctional with grade III –IV TR.

All patients had non-ionic Coronary Angiography many days before the operation. All had pre-operative echocardiograms and some had thallium scans.

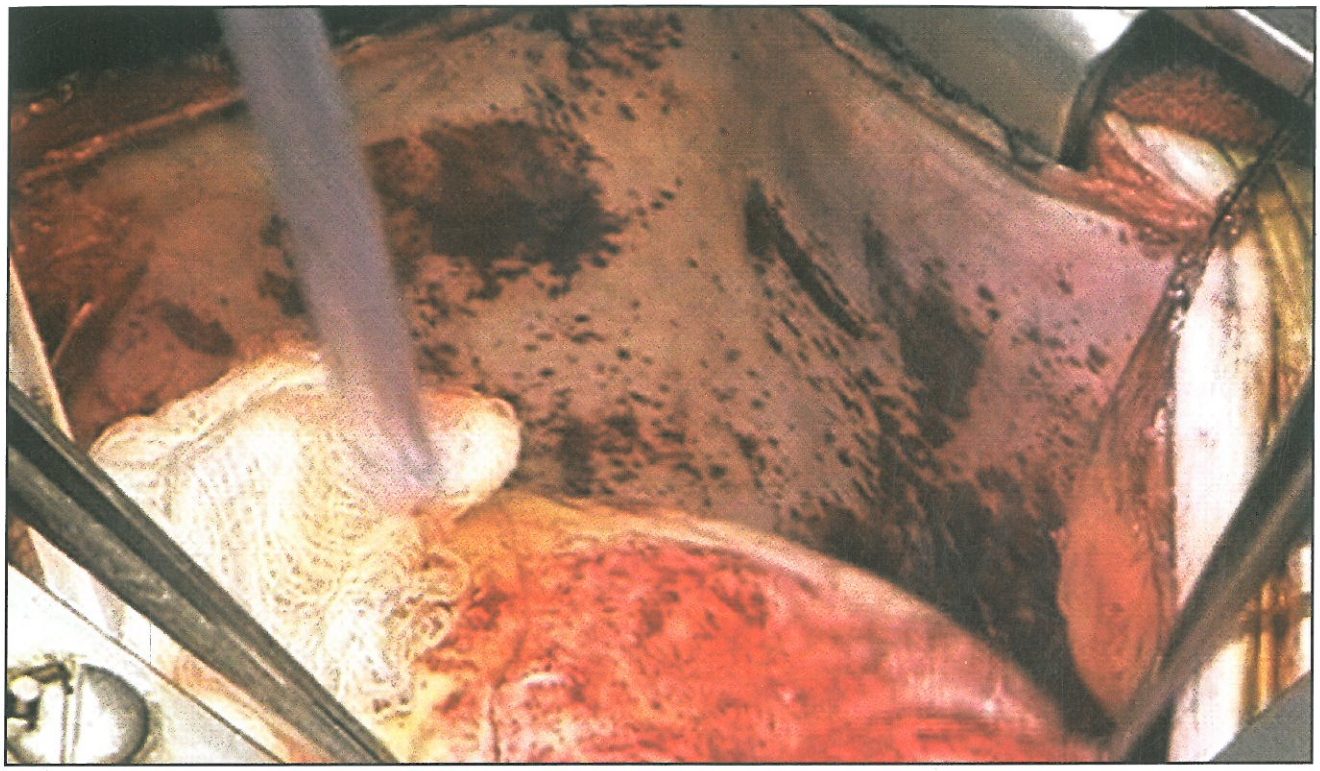


photo-1: An initial assessment of the heart is made on opening the pericardium.

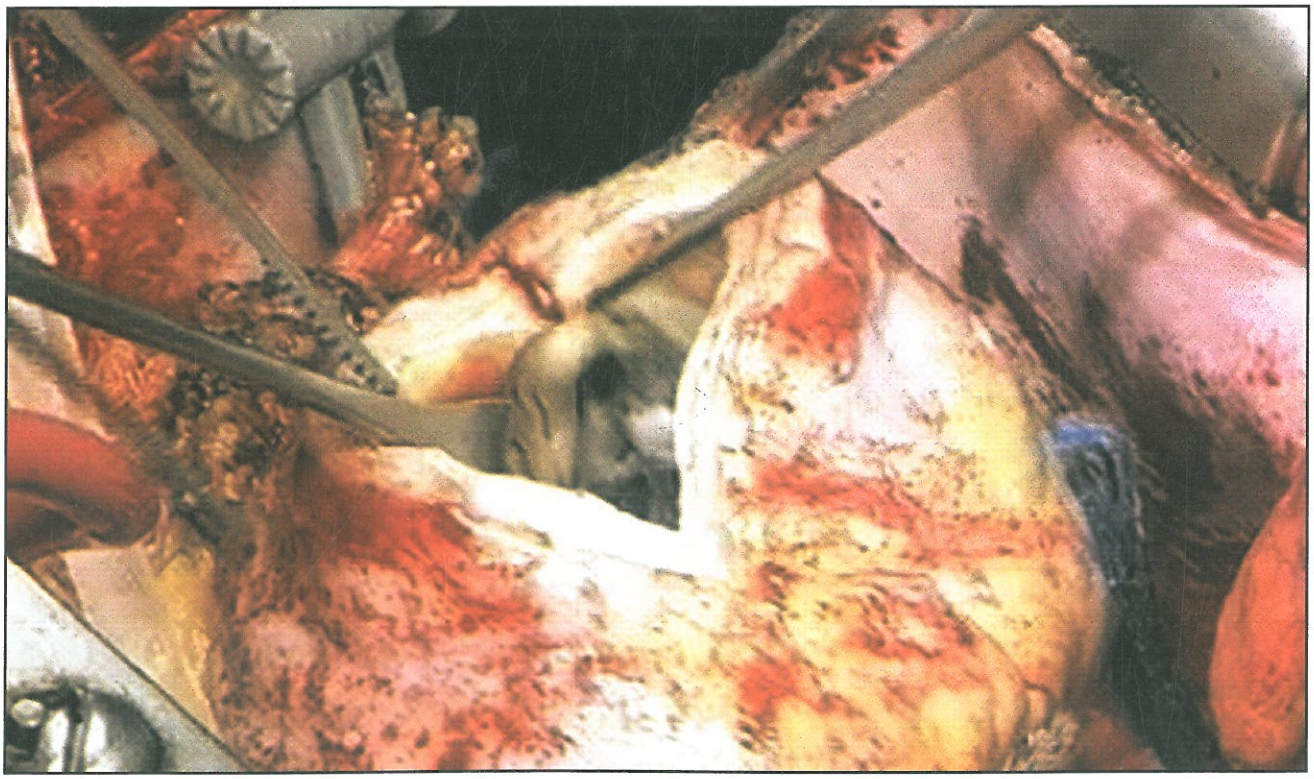


photo-2: Further assessment to see the extent of scar and extension of the first incision over the scarred ventricle.

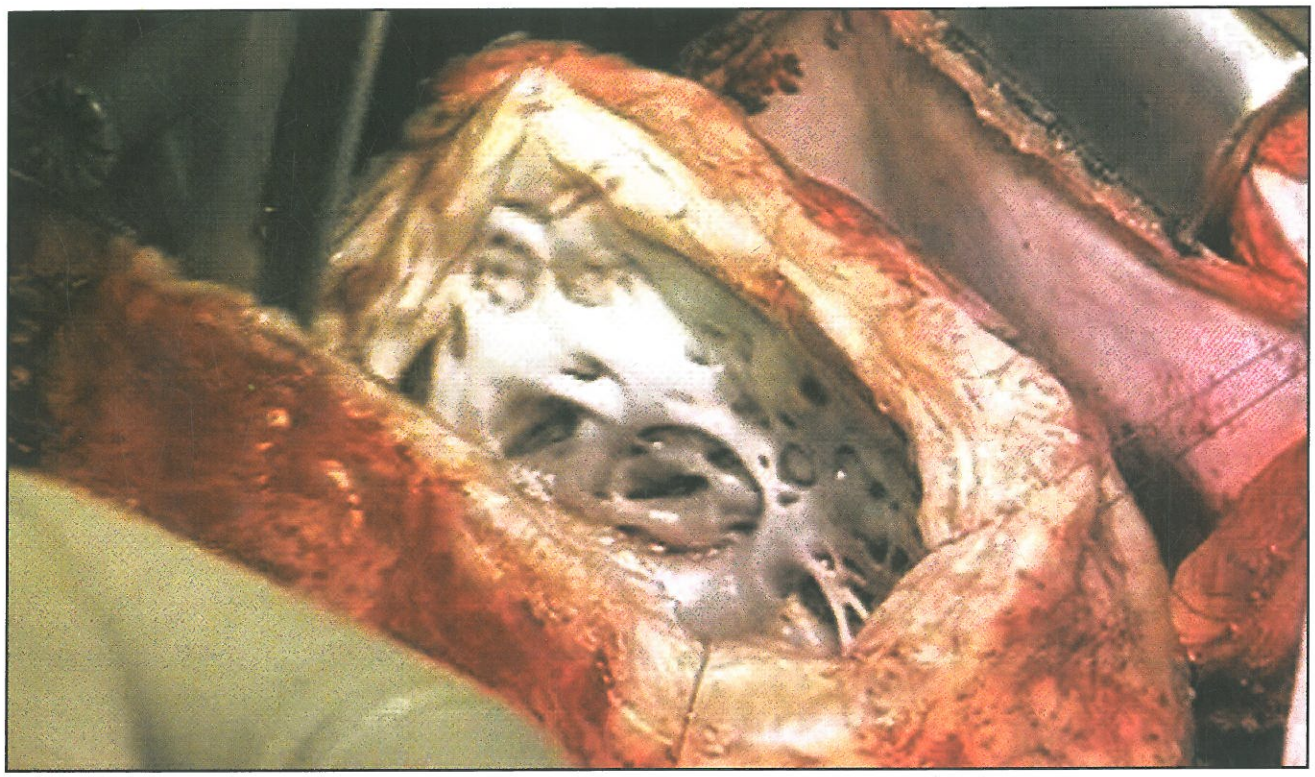


photo-3: At this stage a Fontan or purse string stitch is generally applied at the edge of the viable muscle to reduce the cavity of the left ventricle before a measuring device is used.

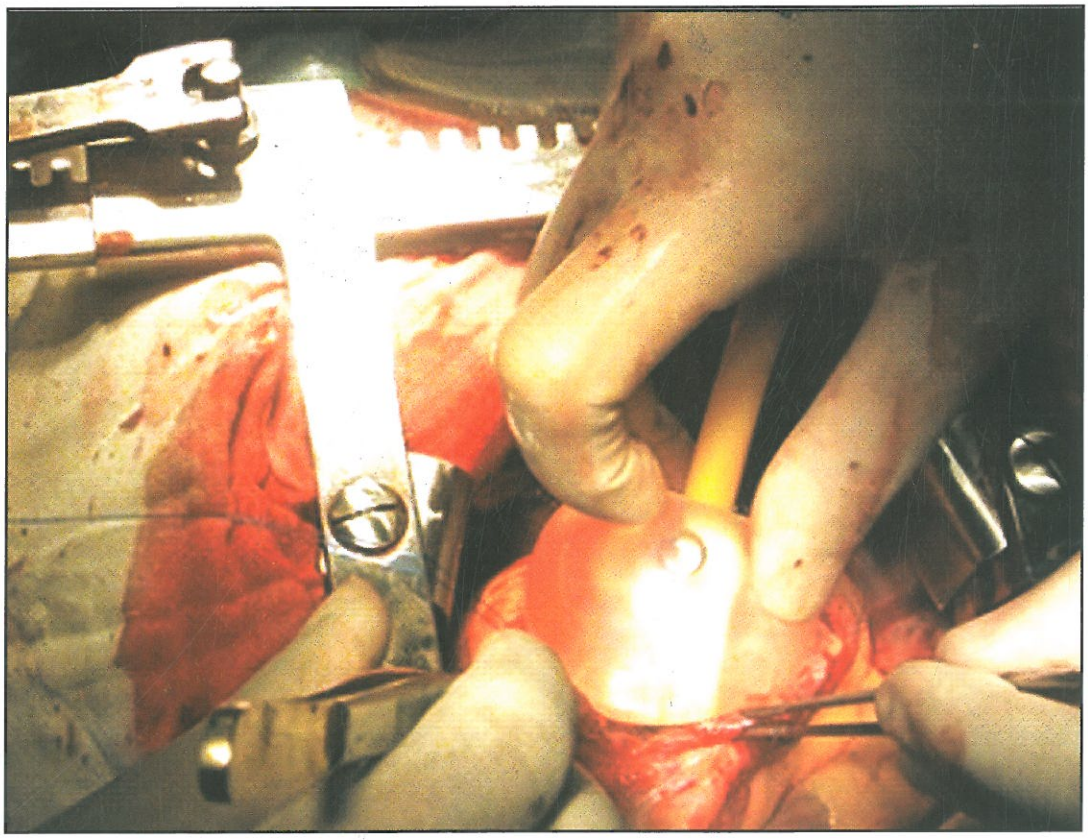


photo-4: Our own variation to duplicate the left ventricular measuring device. This is the largest Foleys catheter that could accommodate 80-85cc of volume of normal saline.

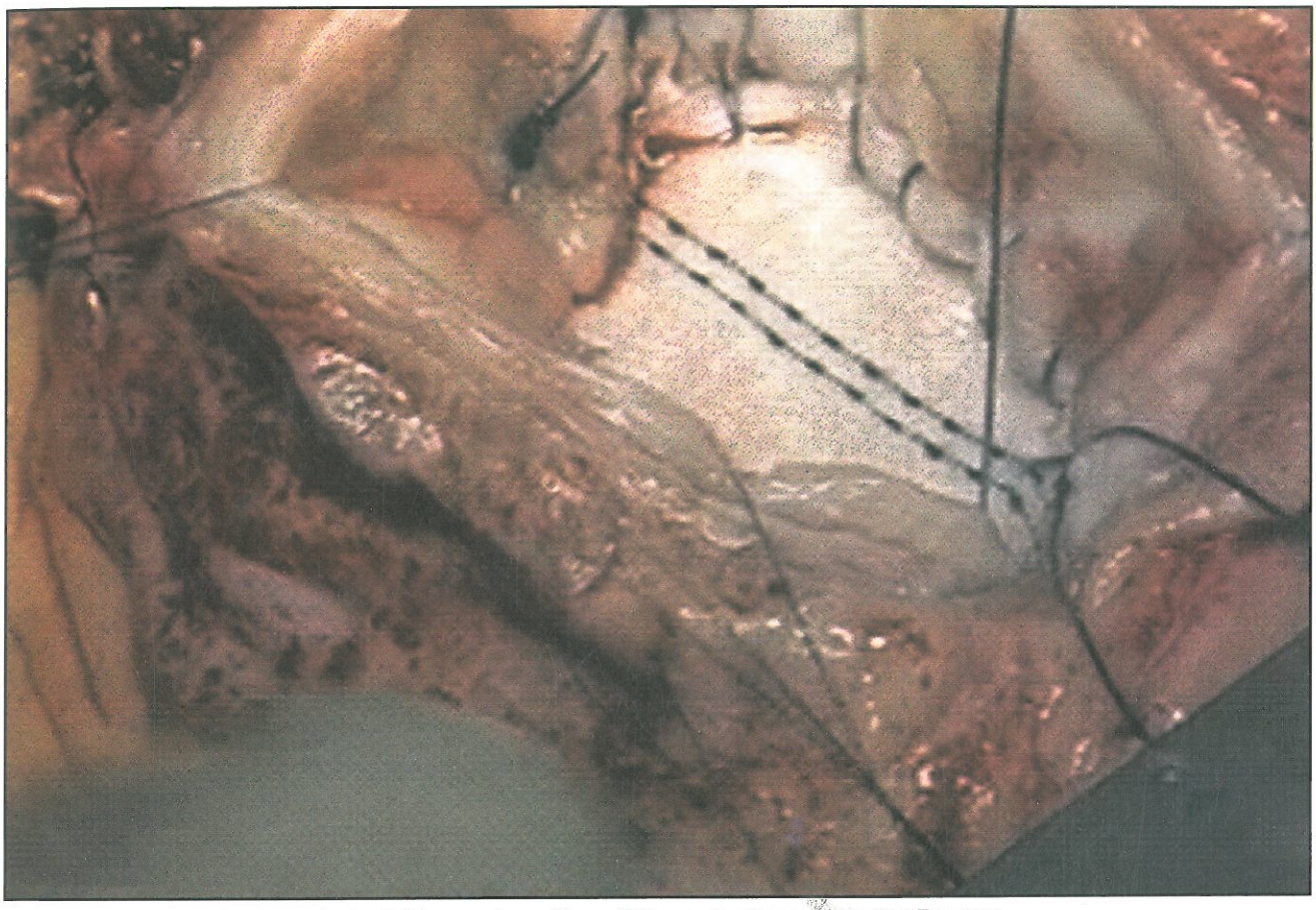


photo-5: Reconstruction of the anterior wall with Dacron.

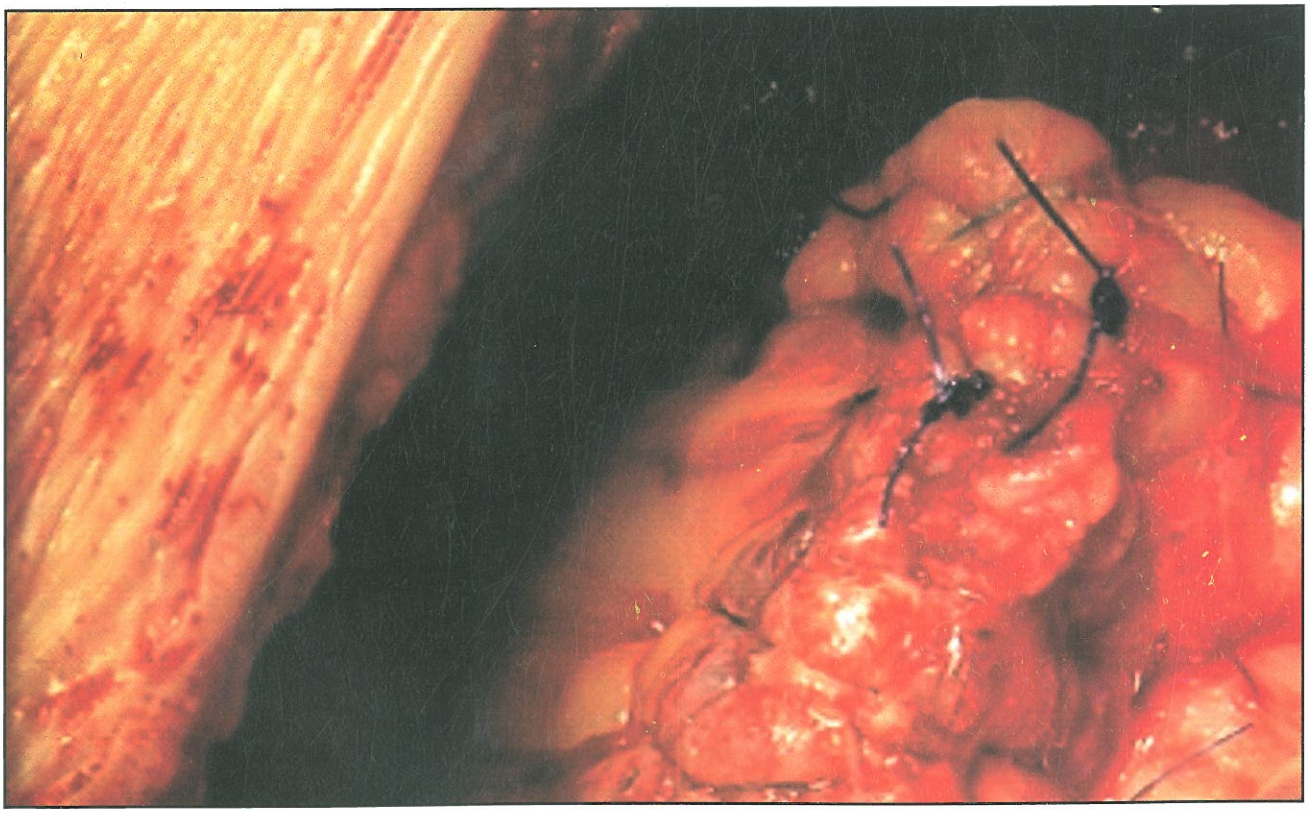


photo-6: The ventriculotomy is closed with a non absorbable suture.

Diabetic-Insulin Dependent Non-Insulin Dependent Non-Diabetics	32 06 04
Renal Dysfunction	26
Hypercholesterolemia	24
H/O Smoking	22
Family history	24
Obesity	11
Preoperative Thallium scan	28
Preoperative echocardiogram	42

Renal Dysfuction defined as Serum creatinine above 1.2mg/dl.
Obesity arbitrarily defined as weight over 90kgs.

Large apical Scar (no=25)	Scar Excision with CABG
Apico-lateral scar (no=06)	Scar Excision with CABG + MVR x 1
Surgical Ventricular Restoration (no=11)	CABG + Valve repair x 2
Valve repair (n=02)	Alfierri repair
Valve replacement (n=01)	

Location of scar and procedure performed.

Scar Excision (no=31)	No LAD Grafting in 11 patients. LIMA to LAD grafting in 10 pts.
	CABG X 3 on average
SVR Group (no=11)	

SCAR EXCISION with CABG. CABG was performed in all patients.

POST-OPERATIVE CHANGES IN EJECTION FRACTION

The EF improved in 31 cases. All patients had echocardiography prior to discharge. There was no improvement in the EF in 11 patients. However, the HF was controlled with medications on follow up as cavity size became much smaller than it was preoperatively. The improvement in EF ranged from 5-25%.

The mean improvement in EF was 15% on patients followed up to 12 months.

MORBIDITY & MORTALITY

Intra Aortic Ballon Pump used in	20
Temporary Dialysis (CVVHF)	16

Permenant Renal failure	02 (both expired on day 11 post-op)
Deaths	06 (14.28%)
Incidence of Temporary Pacing	15
Chest infection	12
Wound Infection	06

LIMITATIONS

- Small number of patients in this group (SVR group 11pts)
- Follow up not complete as many of these patients were from other cities.
- Low number of patients in such operations because the cardiologists had already decided about the inoperabilty of the patients.

SALIENT FEATURES AND CONCLUSIONS[7,9,12]

- Reduces the size of the ventricle.
- Restores the elliptical shape of heart.
- Significantly improves the pumping action of heart.
- Usually done with CABG
- Often done with valve repair
- Improves clinical status (symptoms may improve).
- Readmission to the hospital with heart failure in the literature is reduced by 85% at 18 months.

SVT is a safe and effective operation for the treatment of heart failure.

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