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Original Article

Comparison of the Outcome of Ventricular Septal Defect Closure using Gore-Tex and Glutaraldehyde-treated Autologous Pericardium

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Abstract

Aim: A comparison of glutaraldehyde-treated autologous pericardium and Gore-Tex patch for closure of ventricular septal defect (VSD).

Materials and Methods: Patients undergoing repair for VSD were included in the study. Group 1 used Gore-Tex patch for VSD closure and Group 2 used glutaraldehyde-treated autologous pericardium patch for the VSD closure.

Results: Autologous pericardium is easily available, sterile, and non-immune reaction. Fixation in 0.6% glutaraldehyde improves its handling qualities and reduces the risk of aneurysmal dilation. In our experience, the handling characteristics of glutaraldehyde-treated autologous pericardium are better than other materials. We also find that the elastic glutaraldehyde-treated autologous pericardium is more in harmony with septal movements than synthetic prosthetic materials. Moreover, the incidence of infective endocarditis is reduced post-operatively.

Conclusion: Glutaraldehyde-treated autologous pericardium is an excellent material for surgical patch closure of VSD. It is easily available and does not require sterilization. Further follow-up is required to assess its long-term efficacy.

Key words: Autologous, Glutaraldehyde, Gore-Tex, Pericardium, Ventricular septal defect

INTRODUCTION

The most common congenital cardiac anomaly, ventricular septal defect (VSD),[1-3] may occur as an isolated anomaly or as a part of a complex of anomalies such as tetralogy of Fallot. Small defects may close spontaneously and others may cause no significant disability in an entire lifetime. Patients with cardiomegaly and large left-to-right shunts are unquestionable candidates for the operation. By operating electively, the tendency to develop bacterial endocarditis and valvulitis is virtually eliminated.[4,5]

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In this study, we propose to follow-up patients undergoing repair for VSD over 1 year and look at the variables in relation to the different techniques of operation, materials used for closure, and eventual morbidity and mortality related to the operation.

VSD closure is the most common congenital cardiac surgical procedure 1. Synthetic materials such as Dacron and Gore-Tex patches are used for VSD repair. Previously, Goretex (W.L Gore and Associates, Inc. Newark) was used exclusively in our unit. Autologous pericardium is attractive because it is free, easily available, and sterile.

Experience with bovine pericardial patch closure of congenital VSD is limited 2. We report our experience with glutaraldehyde-treated autologous pericardium for VSD closure in our congenital cardiac surgical practice.

Isolated VSD is a well-known congenital heart anomaly. If discovered in infancy or early childhood surgical intervention

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can be of necessity depending on the size of the defect, to assure a healthy adulthood. The long-term results of surgical closure of VSD in childhood are good and after surgery the children are considered as equally healthy and physically fit as their peers. However, there is inconsistency in data regarding follow-up on this group of patients, in relation to exercise capacity as a measure of the cardiopulmonary function. To further approach this matter the post-operative cardiac factors of these patients have to be investigated.[6-10]

Aims

A comparison of glutaraldehyde-treated autologous pericardium and Gore-Tex patch for closure of VSD.

MATERIALS AND METHODS

All patients undergoing repair for VSD in the Department of Cardiothoracic Surgery at Government Rajaji Hospital were included in the study. Patients with VSD associated complex anomalies were excluded from the study. Group 1 used Gore-Tex patch for VSD closure and Group 2 used glutaraldehyde-treated autologous pericardium patch for the VSD closure.

After routine median sternotomy, the thymus was carefully dissected from the pericardium and partially removed. A free graft of the pericardium was harvested, taking care not to injure the phrenic nerves. It was stretched out on a stiff, sterile cardboard paper to avoid wrinkles. It was treated with 0.6% glutaraldehyde solution for 20 min and rinsed 3 times in 0.9% saline for 5 min.

Cardiopulmonary bypass was established with aorta, superior vena cava, and inferior vena cava cannulation. Under moderate hypothermia (28-30°c) and antegrade cold blood cardioplegic arrest, the right atrium was opened and the VSD was inspected. The pericardial/Gore-Tex patch was trimmed to match the size of the VSD. The defect was closed with the pericardial patch using 4/0 or 5/0 polypropylene continuous suture; starting from the inferior margin and proceeding toward the anterosuperior margin and superiorly toward the aortic valve, avoiding injury to the aortic cusps. With the second arm of the suture, the posteroinferior margin was closed up to the septal leaflet of the tricuspid valve. The tricuspid margin of the defect was closed with a reinforcing strip of pericardium. When using interrupted sutures, pledget-supported interrupted mattress sutures are first placed around all margins of the defect and then passed through an approximately tailored patch, which is lowered down and tied in.

Additional Procedures

Two patients underwent simultaneous aortic valve repair. One patient needed division of hypertrophied infundibular muscle and other needed excision of subaortic membrane. Mitral valve repair done in two patients.

RESULTS

A total of 58 patients were recruited for the study. Of these, 21 had VSD repair using glutaraldehyde-treated autologous pericardial patch and 24 had VSD repair using Gore-Tex patch. In 13 patients, the VSD was small and was closed using direct prolene sutures reinforced with teflon pledgets. Majority of patients were in the age group of 6-10 years comprising 43% of the total study population. Children under 5 years of age comprised <10% of the study group. Male and female patients almost equally distributed in our study with 51.7% of patients are female. Perimembranous VSD contributes majority in our study with 37.9% followed by subpulmonic VSD (Table 1). Most of the VSD operated were of restrictive physiology. The non-restrictive type included mainly the VSD of outlet type (Table 2).

The most common associated anomaly was congenital mitral valve abnormality, mainly cleft mitral valve, and chordal prolapsed leading to significant mitral regurgitation requiring mitral valve repair. Right ventricular outflow tract (RVOT) obstruction was due to hypertrophied RV muscle bundle which required the division of the muscle bundle to relieve the obstruction. Two patients had significant aortic regurgitation due to aortic valve prolapsed. Surgeons using Gore-Tex patch for VSD repair favored the interrupted suture technique and surgeons using glutaraldehyde-treated autologous pericardium favored the continuous suture technique. Pericardial patch used in 36.2% of cases and Gore-Tex patch used in 41.4% of cases. Pledgeted prolene suture closure done in 22.4% of cases (Table 3).

Mortality is 8.6% in our cases. 48% of cases had morbidity most of them are minimal complications recovered in the post-operative period (Table 4).

31% of cases had minimal residual shunt in the immediate post-operative echo and they are on follow-up with medical management (Table 5).

Two patients had infective endocarditis in Gore-Tex patch group. Residual shunt was present in 18 patients; none of them were significant enough to warrant re-exploration and closure. Two patients had nodal rhythm in Gore-Tex patch group and needed temporary pacing. They recovered after 1 week.

Gore-Tex patch closure cases dominate with residual shunt with 45.8% of residual shunt. We use continuous technique

for most of pericardial patch closure and interrupted suturing for Gore-Tex closure (Table 6).

DISCUSSION

A total of 58 patients were recruited for the study. Of these, 21 had VSD repair using glutaraldehyde-treated autologous pericardial patch and 24 had VSD repair using Gore-Tex patch. In 13 patients, the VSD was small and was closed using direct prolene sutures reinforced with teflon pledgets. 65% of patients had restrictive hemodynamics. The remainder had large VSD of mainly subaortic type. The most common VSD was outlet type comprising 50% of the study population. Muscular VSD was the least common with only 8% of the population.[11-15] Continuous suture techniques[4] were used in 40% of the study group. Most of the patients in the continuous suture technique group were from the pericardial group. Pericardial patch treated with glutaraldehyde was more flexible and had better handling properties compared to the Gore-Tex patch was a contributing factor for ease of surgery. The rest had interrupted suture technique and all of them were from the Gore-Tex group. They were mainly operated on by a single surgeon during this study duration and it may have contributed to the use of the same technique in this group.[16-18] The most common associated anomaly was congenital mitral valve abnormality, mainly cleft valve, and chordal prolapsed leading to significant mitral regurgitation requiring mitral valve repair. Chordal shortening was done and cleft in the anterior leaflet was closed 5-0 prolene sutures. Post-operatively, one patient who underwent mitral valve repair needed prolonged ventilation and tracheostomy due to residual mitral regurgitation and cardiac failure. He was weaned off ventilator and tracheostomy tube was removed before discharge.

RVOT obstruction was commonly due to the hypertrophied RV bundle which required division of the muscle bundle to relieve the obstruction. Two patients had significant aortic regurgitation due to aortic valve prolapsed. They were approached using transaortic route[1] and modified Trusler's repair was done to correct the prolapsed right coronary cusp. One patient had anomalies muscle bundle in RV along with subaortic membrane and both were excised. PFO were closed.[19]

All the patients except three were closed using transatrial approach.[2,3] MV repair was done through interatrial septum. Two patients needing aortic valve repair were approached through aortic exposure and one patient with subpulmonic VSD was repaired through transpulmonary approach.[2] Two patients had nodal rhythm in Gore-Tex patch group and needed temporary patching. They recovered after 1 week. Two patients had infective endocarditis in Gore-Tex patch group. Residual shunt was present in 14 patients; none of them significant enough to warrant re-exploration and closure. Two patients suffered neurological deficits in the immediate post-operative period. Computed tomography scan of brain showed areas of infarct in one of the patient and cerebral edema in the other. Both of them were managed with antiedema measures and recovered

Table 1: Type of VSD

Diagnosis	Percentage of patients
Subpulmonic	20.7
Subaortic	31
Perimembranous	37.9
Muscular	8.6
Inlet	1.7

VSD: Ventricular septal defect

Table 2: Type of hemodynamics

Type of hemodynamics	Percentage of patients
Restrictive VSD	87.9
Non-reactive VSD	12.1

VSD: Ventricular septal defect

Table 3: Patch material

Patch material used	Percentage of patients
Pericardium	36.2
Gore-Tex	41.4
Pledgeted	22.4

Table 4: Complications

Complications	Percentage of patients
Block	3.4
Stroke	3.4
IE	3.4
Renal failure	1.7
Residual shunt	31
Other complications	32.8
Death	8.6

Table 5: Residual shunt

Residual Shunt	Percentage of patients
Yes	31
No	69

Table 6: Patch material and suture technique

Patch material used	Suture techniques	
	Continuous *N* (%)	Interrupted *N* (%)
Pericardium (21)	20 (95.2)	1 (4.8)
Gore-Tex (24)	3 (12.5)	21 (87.5)
Pledgeted (13)	-	13 (100)

successfully. When seen at 1-year follow-up both of them had regained full functional recovery. One patient had pre-renal failure in the immediate post-operative period and was managed conservatively. His renal parameters returned to normal baseline levels in 5 days.

Post-operative echo showed residual shunt in 18 patients. None of them were significant enough to warrant re-exploration and closure. None of them were from the Gore-Tex patch group and majority was outlet type of VSD. The residual shunt was significantly more in interrupted suture technique and whom Gore-Tex was used for VSD closure, irrespective of the type of VSD.

Two patients in the Gore-Tex group had infective endocarditis[5] and were successfully treated with antibiotics based on culture reports for 3 weeks duration. Of the four patients who died in the immediate post-operative period, three died of post-operative cardiac failure and one patient due to post-operative pulmonary hypertensive crisis. Majority of the complications were in the group operated by a single surgeon. This may have contributed to the differences in complications rate in this series when compared to other standard data published.

Limitations

This study is limited by its non-randomized nature and the inherent limitations of non-randomized studies. Only those patients who were referred for surgery and underwent surgical repair were reviewed. Indications for surgery are based on the retrospective review of the referring cardiologist's clinical notes and the surgical pre-operative note. Although this study did not address long-term follow-up for these patients, long-term survival and clinical outcome for patients after surgical closure of isolated VSD is consistently excellent, and we would anticipate the same for this study population. In addition, we intentionally excluded patients with multiple VSDs. We recognize patients with multiple VSDs can be a challenging group for the surgical repair. However, the focus of this study was patients with isolated, single VSDs.

CONCLUSION

Autologous pericardium is easily available, sterile, and non-immune reaction. Fixation in 0.6% glutaraldehyde improves its handling qualities and reduces the risk of aneurysmal dilation. In our experience, the handling characteristics of glutaraldehyde-treated autologous pericardium are better than other materials. We also find that the elastic glutaraldehyde-treated autologous pericardium is more in harmony with septal movements than synthetic prosthetic materials. Moreover, the incidence of infective endocarditis is reduced post-operatively. In a country like ours with limited financial resources, glutaraldehyde-treated autologous pericardium is a good alternative material to be used for repair of VSD.

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