# **Original Research Article**

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# Management of the ruptured sinus of valsalva aneurysmsa

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### **ABSTRACT**

**Background:** RSOV is associated with a dramatic onset of symptoms to a state of biventricular failure due to sudden volume overload. Controversies exist about RSOV repairs among various centers are the surgical approach (chamber involved, transaortic or both) and the closure technique (primary/ patch closure). There have been no clinical trials to show that one technique is superior to other. In the present study, we reviewed our 16 years' experience with repair of RSOV through exclusive transaortic approach.

**Methods:** 40 patients underwent RSOV repair through transaortic approach from January 2000 to December 2016. The mean age was 30.2 years. The origin of RSOV was right coronary sinus in 75% of cases and non-coronary sinus in 22.5% of cases. There was one giant calcified unruptured aneurysm arising from right coronary sinus. Right ventricle was most common chamber of rupture comprising 96.67% cases. All patients underwent transaortic repair of RSOV using dacron patch. VSD repair was done in 25% cases. Aortic valve replacement was done in 62.5% cases for moderate to severe AR.

**Results:** There were 7.5% in hospital deaths with no late deaths. Inotropic and ventilatory support required for  $3\pm1.6$  days and  $1.8\pm1.2$  days respectively. The mean ICU stay and hospital stay was  $3.5\pm1.6$  days and  $7.5\pm2.5$  days respectively. None of the patient required permanent pacemaker implantation. The 37 survivors were followed up for  $6.4\pm3.6$  years; all had an improvement in functional NYHA class with superior results in those with no aortic regurgitation. 7.5% patients developed mild AR during follow up which medical management was done.

**Conclusions:** Surgical treatment of ruptured sinus of Valsalva aneurysm using the transaortic patch technique has an acceptably low operative risk, lesser distortion of aortic valve and good long-term symptom-freedom survival. An early aggressive approach is recommended to prevent worsening of symptoms and more extensive disease.

Keywords: Aortic surgery, Aortic sinus, Biventricular failure, Transaortic patch technique

## **INTRODUCTION**

Rupture of sinus of valsalva aneurysm (RSOV) is associated with dramatic onset of symptoms and deterioration to a state of biventricular cardiac failure due to sudden volume overload.<sup>1,2</sup> Clinical presentation is less severe in case of preexisting ventricular septal defect (VSD). Diagnosis is an indication for early surgical

intervention, as the mean survival period for untreated RSOV patients is 1-3.9 years.<sup>2</sup> A review of literature reveals limited surgical experience of RSOV repair with each institute operating only 4 to 5 cases annually with a higher incidence in the Asian population. Various surgical techniques i.e. patch versus direct closure and various approaches i.e. through the involved cardiac chamber, through aortotomy or combined approach have

been reported. The aim of the present study was to report our analyse our results of the RSOV repair using dacron patch closure through the trans-aortic approach.

### **METHODS**

From January 2000 to October 2016, 40 patients underwent RSOV repair at Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi, India. The medical records were reviewed to evaluate clinical presentation, pathophysiologic findings, surgical treatment, hospital morbidity and mortality.

The study group included 30 male and 10 female patients who underwent RSOV repair with mean age of 30.2 years (range-18 to 50 years). Time from onset of symptom to surgery was 90.9±110.11 days. Major symptoms were

breathlessness in 30 (75%), palpitation in 20 (50%), and fatigue in 15 (37.5%) patients (Table 1).

**Table 1: Patient characteristics.** 

| Variable                                     | N (N=40)    |
|--|-------------|
| Male/female                                  | 30/10       |
| Age (years)                                  | 30 (18-50)  |
| Time from onset of symptom to surgery (days) | 90.9±110.11 |

At the time of admission 28 patients (70%) were in NYHA Class III, 10 patients (25%) were in NYHA Class II and 02 (5%) were in NYHA Class I (table 5). Chest X-ray revealed cardiomegaly in all the patients with mean cardiothoracic ratio of  $60\pm5\%$ .

Table 2: Origin and site of rupture.

|                      | Chamber of ruptur | e            |               |                    |
|----------------------|-------------------|--------------|---------------|--------------------|
| Origin               | Right ventricle   | Right atrium | Other chamber | Number of patients |
| Right coronary sinus | 29                | 1            | 0             | 30                 |
| Non-coronary sinus   | 0                 | 9            | 0             | 9                  |
| Left coronary sinus  | 0                 | 0            | 0             | 0                  |
| Total                | 29                | 10           | 0             | 39                 |

Electrocardiography showed atrial fibrillation with fast ventricular rate in 10 (25%) patients, left ventricular hypertrophy in 25 (62.5 %) patients and biventricular hypertrophy in 10 (25%) patients. On echocardiography, the diameter of neck of Valsalva aneurysm was less than 1 cm in 32 (80%) patients and more than 1 cm in 7(17.5%) patients (Table 3).

Table 3: Diameter of the neck of sinus of valsalva aneurysm.

| Diameter | Number of patients |
|----------|--------------------|
| ≤ 1 cm   | 32                 |
| > 1 cm   | 7                  |

Cardiac catheterization and angiography were done in all patients to confirm the diagnosis and rule out coronary artery disease. The origin of RSOV was right coronary sinus in 30 (75%) patients and non-coronary sinus in 9 (22.5%) patients. Out of 30 patients with right coronary sinus RSOV, 29 (96.67%) ruptured in the right ventricle and 1(3.33%) ruptured in the right atrium (Table 2).

There was a giant calcified un-ruptured Sinus of Valsalva aneurysm arising from right coronary sinus in one patient. Coexisting cardiac lesions were supracristal ventricular septal defect (VSD) in 10 (25%) patients and moderate to severe aortic regurgitation 25 (62.5%) patients (Table 4).

Table 4: Coexisting lesions and corresponding procedures in 40 Patients with sinus of valsalva aneurysm.

| Lesion   | Procedure                 | No. of patients |
|--|---------------------------|-----------------|
| Mod-severe Aortic regurgitation                            | Aortic valve replacement  | 25              |
| VSD  | VSD patch closure         | 10              |
| Severe tricuspid regurgitation                             | De' vegas<br>annuloplasty | 5               |
| Giant calcified<br>aneurysms of right<br>sinus of valsalva | Root replacement          | 1               |

Table 5: Pre-and postoperative NYHA functional class.

| NYHA | Pre-OP | Post- Op |
|------|--------|----------|
| I    | 2      | 18       |
| II   | 10     | 18       |
| III  | 28     | 1        |
| IV   | 0      | 0        |

## Surgical technique

Median sternotomy approach was used. Cardiopulmonary bypass was instituted using aortobicaval cannulation with moderate hypothermia in all the cases. The left ventricle was vented through right superior pulmonary vein. Oblique aortotomy was done and cold blood ostial cardioplegia was infused. Orifice of the aneurysm was visualized. Right aortic cusp was elevated to reveal the underlying VSD. Ruptured SVA was repaired with dacron patch using interrupted plegeted prolene suture through the aortotomy in all the patients taking care to avoid any distortion of the sinus and aortic valve cusp. Aortic valve replacement was done in 25 (62.5%) patients with moderate to severe aortic regurgitation using bileaflet mechanical prostheses (Medtronics ATS). VSD closure using dacron patch with exclusive transaortic approach was done 10 in (25%) patients. One patient had giant calcified aneurysm of right sinus of Valsalva for which ascending aorta replacement was done using dacron tube graft with re-implantation of right coronary artery with preservation of the native aortic valve. The mean aortic cross-clamp time was 39.3±22.2 minutes (range: 24-95 minutes), and the mean cardiopulmonary bypass time was 52.5±23 minutes (range: 30-132 minutes).

### Statistical analysis

Student's t-test was used, and values of p<0.05 were considered significant. Data are presented as mean  $\pm 2$  standard deviation.

### **RESULTS**

There were 3 (7.5%) in hospital deaths. 02 patients had concomitant aortic valve replacement, had preoperative severe left ventricular dysfunction, suffered low cardiac output syndrome with multi organ dysfunction. Third patient who had VSD closure and aortic valve replacement died because of acute renal failure and septic shock. Mean duration of ventilatory support was  $1.8\pm1.2$  days. Mean duration of inotropic support was  $3\pm1.6$  days. Mean ICU and hospital stay was  $3.8\pm1.6$  days and  $7.5\pm2.5$  days respectively (Table 6).

**Table 6: Post-operative parameters.** 

| Variable                        | Days    |
|---------------------------------|---------|
| Inotropic support (days)        | 3±1.6   |
| Mean Ventilatory support (days) | 1.8±1.2 |
| Mean ICU stay (days)            | 3.5±1.6 |
| Mean hospital stay (days)       | 7.5±2.5 |

Post operatively 09 (22.5%) patients developed atrial fibrillation with fast ventricular rate which was successfully managed medically. 05 (12.5%) patients developed temporary AV block which was managed with temporary epicardial pacemakers. AV block resolved in all the patients by the time of discharge. None of the patients required permanent pacemaker implantation. The 37 survivors were symptomatically improved at the time of discharge from the Hospital with significant

improvement in functional NYHA class (table 5). Post-operative echocardiography showed no leak at the RSOV repair and VSD closure. The aortic valve was competent in all the patients who underwent AVR. There was no periprosthetic leak. In patients undergoing exclusive repair for aneurysm, 03 (7.5%) patients had developed mild aortic regurgitation during follow up which was managed conservatively. The 37 survivors were followed up for 6.4±3.6 years. Follow-up was done at 1 month, 3 months, 6 months then yearly on an out-patient basis. There was no late death.

### DISCUSSION

RSOV is a rare cardiac anomaly with the reported incidence of (0.5%-1.5%) in western and (1.2%-4.94%) in Asian population.<sup>3,4,8</sup> Most frequently it is congenital in origin due to either a congenital absence of continuity between the aortic media and the annulus fibrosus, or a developmental structural defect in the aortic annulus itself which can gradually give way under aortic pressure to form an aneurysm. The aneurysm can rupture into a low pressure cardiac chamber. The other causes include trauma, bacterial endocarditis, syphilis, cystic medial necrosis and atherosclerosis.1 It commonly originates in the right coronary sinus followed by non-coronary sinus and ruptures into the right ventricle followed by right atrium, which is similar to our experience.3-5 The left coronary cusp does not usually arise from the bulbar septum as do the right and noncoronary cusps, thus explaining the rarity of ruptured left sinus of Valsalva aneurysm. In most of the patients diagnosis is generally made in the third decade and out of them 51-88% are males.<sup>6-8</sup> In present study the mean age of presentation was 30.2 years and 75% were males. The natural history of RSOV is difficult to determine due to rarity of these lesions.

As the reported mean survival of these patients with untreated RSOV is 3.9 years and in view of dramatic clinical presentations of sudden onset biventricular failure, reported low perioperative mortality and high long term survival after surgery, an early surgical intervention is indicated as soon as the diagnosis is made.<sup>2</sup> The most common coexisting cardiac anomaly with RSOV is VSD with an incidence ranging from 09-78%. 6,8,9 As the VSD may be obscured by the sinus aneurysm in the preoperative workup, a meticulous search for VSD is recommended at the time of RSOV repair even if none is reported. 10 In present study, VSD was found in 25% of the cases and Dacron patch closure was done in all cases. One patient who underwent RSOV repair with VSD closure and AVR died due to acute renal failure and septic shock. There was no residual or recurrent VSD at follow up in the rest 09 survivors.

In these patients, aortic valve abnormalities and regurgitation necessitating aortic valve repair / replacement has been reported in 3-48% and 5-35% respectively. 1,2,8 AVR may be required at the time of

RSOV closure if the cusps are highly deformed and not suitable for repair.<sup>11</sup> In present series, moderate to severe aortic regurgitation (AR) was present in 62.5% of patients requiring an AVR in all cases.

The goals of RSOV repair procedures are to close the RSOV securely, remove the aneurysmal sac and repair any associated defects without causing heart block or aortic valve dysfunction. There have been no clinical trials to show that one surgical repair technique is superior to another due to rarity of the lesion. Even interventional closure of RSOV in the cardiac catheterization laboratory has been reported. However, the optimal surgical approach is yet to be defined. Controversies exist about RSOV repairs among various centers are the surgical approach (chamber involved, transaortic or both) and the closure technique (primary/patch closure).

The transacrtic approach can easily expose the acrtic root, competence and the severity of the pathologic changes of the aortic valve, proper position of RSOV and coronary ostia. This approach allows the accurate placement of the suture without fear of injury to the coronaries or the aortic cusps. This might be the reason for a lower incidence of progression of AR in our series. Review of the literature reveals that this approach has been used in 11.3%±14.4% of RSOV repair because of fear of missing the VSD and of post-operative aortic regurgitation by progressive distortion of the sinus geometry. <sup>13</sup>. In a study done by Liu et al no association was found between surgical approach and the aortic regurgitation.<sup>14</sup> Chamber only approach is preferentially used in patients without significant AR. It was thought that by not closing the origin of RSOV, no foreign material is left in the aortic sinus and the risk of distortion of the aortic sinus was minimized.

However, by leaving the communication between the aortic sinus and the aneurysmal sac, there is a risk of bacterial colonization or thrombus formation inside the aneurysm and of recurrent fistula formation and rupture of aneurysmal sac left.<sup>5</sup> The dual chamber approach, though has the advantage of both, but is time consuming process.<sup>7,10,15-17</sup> Considering our experience, we advocate the transaortic approach in all the patients as it provides assessment of aortic root, valve leaflets, localization of RSOV, the coronaries and the underlying VSD.

Techniques recommended to close the RSOV includes patch closure or direct repair using interrupted plegeted sutures. <sup>18</sup> Primary closure of RSOV has potential disadvantages like deforming the aortic sinus, interrupting aortic competence and suture line stress leading to recurrence. Recurrence of RSOV and worsening of AR has been reported after primary closure. <sup>5,8,10,18</sup> Patch closure of RSOV is recommended (60.3%±26.4%) of cases in reviewed reports) as it avoids deformity of the aortic valve and reduces the stress on the

suture line. <sup>5,7,19,20</sup> In our series, we have performed patch closure to repair RSOV with good postoperative results.

The operative mortality of RSOV repair is 0.5-11% 5-12 with good long term prognosis. In present series the operative mortality was 7.5% and the survival rate was 92.5% at mean follow-up of  $6.4\pm3$  years.

### **CONCLUSION**

Surgical treatment of ruptured sinus of Valsalva aneurysm using the trans-aortic patch technique has an acceptably low operative risk and good long term results with lower incidence of residual or recurrent RSOV and VSD and progression of aortic regurgitation. An early surgical intervention is recommended to prevent worsening of symptoms at the time of intervention.

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