Outcomes of Ventricular Septal Defect Repair in Various Anomalies: a Single Institute Experience and Literature Review

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Abstract

Background- This is a single institute retrospective study (from 2007 to 2008) to evaluate how patient related factors (age, weight) and type or anatomical location of ventricular septal defect (VSD) could affect the outcome of surgery.

Methods- Patients with any diagnosis who had undergone ventricular septal defect repair (a total of 252 patients) from 2007 till early 2008 at our center were evaluated retrospectively for factors which might be responsible for developing residual ventricular septal defects and heart block. Data were analyzed through univariate and multivariate analysis.

Results- There was 2 deaths among 252 patients (0.8%). The incidence of postoperative residual ventricular septal defect was 28.2% ± 2.8* (71 of 252), but only 3 of them (4.2%) needed reoperation. Neither patch material (p=0.572), nor type (p=0.349) or size (p=0.599) of ventricular septal defect had any effect on this complication. The mean age and weight of patients who had residual ventricular septal defect compared to those who did not were not significantly different, although they were somewhat lower (4.7 ± 0.7 vs. 5.2 ± 0.4 years, p=0.537; and 15.4 ± 1.7 vs. 17.9 ± 1.1 kg, p=0.222, respectively). There were five patients (2.0%) with postoperative complete heart block (CHB) and again this was independent of the patients' age, weight and surgical approach (transatrial or transventricular). Patients with history of previous Blalock-Taussig (BT) shunt proved to have postoperative bleeding more commonly (13%, 6 of 46 patients) than patients who had not (3.4%, or 7 of 206 patients, p=0.009). Also in patients with a history of BT shunt compared to those without it, postoperative pericardial effusion (6.5% versus 1.5%, P=0.04) and pneumonia (4.3% versus 0.5%, P=0.025) were more common.

Conclusion- It seems that for VSD repair, there are no limitations such as weight or age to proceed with the definitive surgery. Also the incidence of complications is independent of the type of anomaly or approaches for closing the defect. Finally, BT shunt has its own complications which are neither rare nor minor, so it is advisable to proceed with the definitive surgery at the first time to avoid the complications associated with BT shunt ***(Iranian Heart Journal 2009; 10 (4):40-44).***

Key words: ventricular septal defect ■ residual shunt ■ complete heart block

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*All numbers with (±) represent standard error of mean (SE), multiply it easily by a factor of 1.96 for 95% Confidence Interval and by 1 for 70% CI.

Repair of ventricular septal defects is associated with a number of complications, namely residual shunting and complete heart block.

The purpose of this retrospective study was to assess how these complications might be related to factors such as patient characteristics (weight, age), previous palliative surgery, approach of repair, location of VSD and primary cardiac anomaly.

Methods

Patients with any diagnosis who had undergone VSD repair from 2007 till early 2008 at our center were studied retrospectively. We evaluated factors which might be responsible for developing residual VSD and heart block and the data were analyzed through univariate and multivariate analyses.

There were 252 patients with a mean age of 5.0 ± 0.4 years (range: one month to 33 years) and mean weight of 17.2 ± 0.9 kg. The most common type of VSD was subaortic (90%, n=227), followed by sub-pulmonic (3%, n=8), inlet type (3%, n=8), muscular (2%, n=5) and multiple (2%, n=5). The diagnoses, in order of frequency, were tetralogy of Fallot (42.9%, n=108) isolated VSD (41%, n=103), double outlet right ventricle, DORV, 7.5%, n=19), atrio-ventricular septal defect, AVSD, 4%, n=10), transposition of great arteries, TGA, 2.4%, n=6) and others (2.4%, n=6, Fig. 1). Approaches for ventricular septal defect closure and their frequencies are presented in Fig. 2.

Results

There were 2 deaths among 252 patients (0.8%); the first case was a six year-old patient with the diagnosis of transposition of the great arteries who had previously undergone systemic-to-pulmonary artery shunt and the other one was a one year old infant with the diagnosis of tetralogy of Fallot who died of heart failure.

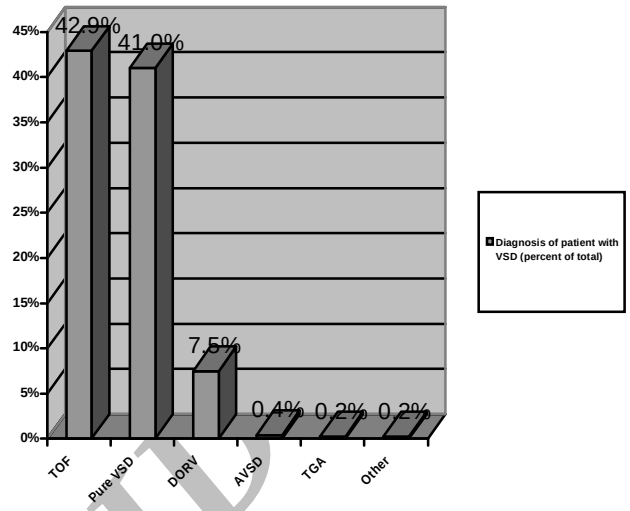

Fig. 1. Percent of patients with VSD in various anomalies.

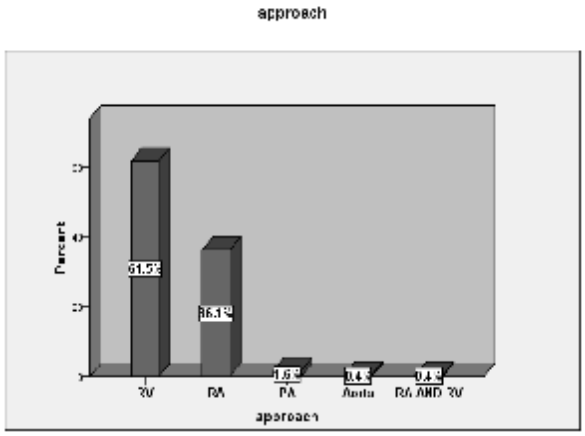

Fig. 2. Frequency of approaches of VSD closure.

Of 108 patients with the diagnosis of tetralogy of Fallot, 33 (31%) had had previous modified BT shunt. This figure was 31.5% (6 of 19) for DORV, 20% (2 of 10) for AVSD, and 16% (one of 6) for patients with TGA (transposition of great arteries).

The incidence of postoperative residual ventricular septal defect was 28.2% ± 2.8 (71 of 252), but only three of them (4.2%) needed reoperation. The average size of the residual

ventricular septal defect was 4.7 ± 0.7 mm for patients who underwent re-operation and 3.1 ± 0.2 mm for those who did not, but the difference was not statistically significant.

There were five patients (2.0%) with post-operative complete heart block (CHB). The percentage of heart block was 2.6% for the right ventricular approach (4 of 155) and 1.1% for the right atrial approach (1 of 91), but the difference was not statistically significant (p=0.426). All cases of heart block occurred in patients with sub-aortic ventricular septal defect (5 of 5), but this was not conclusively significant (p=0.089). The mean age and weight of patients who developed heart block compared to those who did not, although lower (age: 1.6 ± 2.5 versus 5.1 ± 0.4 years, and weight: 9.7 ± 6.4 versus 17.4 ±0.9 kg, respectively), were not significantly different (p=0.165 and p=0.235, respectively).

Discussion

All patients were operated through standard median sternotomy incision. Kadner et al. reported muscle-sparing right lateral mini-thoracotomy using inguinal vessel cannulation and superior vena cava and right atrial approach for closure of isolated ventricular septal defects with excellent cosmetic results and no residual defect or conduction disturbance, they were even capable of repairing three concomitant aortic valve regurgitations through this approach.[1] Other approaches include partial (lower) median sternotomy,[2] and thoracoscopic surgery with femoral cannulation.[3]

As Sir Isaac Newton said, let the data speak for themselves: after correction for age and weight using univariate analysis, patients with history of previous BT shunt proved to have more common postoperative bleeding (13%, 6 of 46) than patients who had not (3.4%, or 7 of 206, p=0.009, Fig. 3), that is most probably due to the need for dissecting the adhesions to expose the shunt.

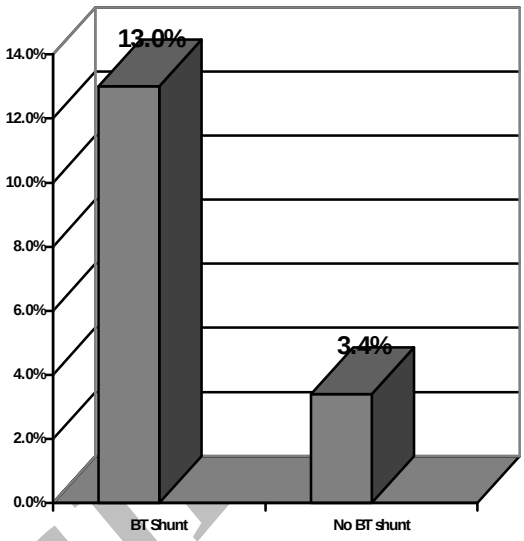

Fig. 3. Incidence of bleeding in patients with and without previous BT shunt.

Also in patients with a history of BT shunt compared to those without it, postoperative pericardial effusion (6.5% versus 1.5%, p=0.04) and pneumonia (4.3% versus 0.5%, p=0.025) were more common. In a review of the literature, there were many other complications of BT shunt, including diaphragmatic paralysis due to phrenic nerve injury[4] (13% in Joho-Arreola study), pulmonary artery distortion (so it was recommended to divide the shunt at the time of corrective operation to prevent distortion with growth)[5], aortic regurgitation in patients with bicuspid aortic valve[6] and enlargement of left heart chambers.[7]

The incidence of complete heart block was 2% in our series, while in our review of other series, this figure varied between 1%[8] and 8 %.[9] One interesting solution to prevent this complication, as described by Ozal et al. was to close the inferior margin of a perimembranous defect in the beating heart; whenever block resulted they removed and replaced the suture. Using this technique they had no instance of complete heart block compared to 7.5% in their control group with the standard technique.[9]

The incidence of residual shunt in our patients was 28%, however as mentioned above only three of them needed re-operation, Neither patch material (p=0.572), nor type (p=0.349) or size (p=0.599) of ventricular septal defect had any effect on this complication, although in one study the incidence of late residual shunt was significantly higher in patients with subpulmonic versus other types of perimembranous defects (33% vs. 6%, p=0.029).[10] Also the type of approach had no contribution to its prevalence (p=0.488). Patients with small residual ventricular septal defect were significantly more symptomatic than those without it (8 ± 4% versus 0%, p<0.0001, Fig. 4).

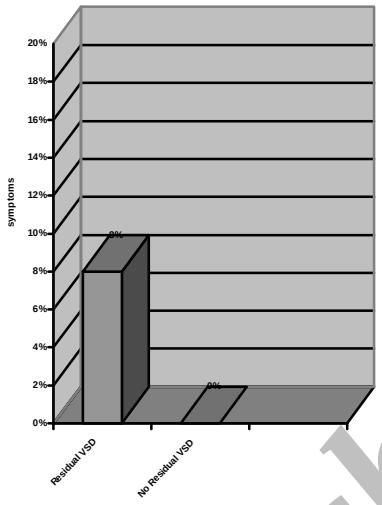

Fig. 4. Percent of symptomatic patients with and without residual VSD.

No other complication was more common in patients with residual ventricular septal defect (e.g. pleural or pericardial effusion, pneumonia and death). Some reports indicate that lower age and weight at operation is associated with higher prevalence of residual defects,[11] yet others did not find such a relationship.[12] In our series, the mean age and weight of patients who had residual ventricular septal defect compared to those who did not, were not significantly different, although they were somewhat lower (4.7 ± 0.7 versus 5.2 ± 0.4 years, p=0.537, and 15.4 ± 1.7 versus 17.9 ± 1.1 kg, p=0.222, respectively).

Conclusion

It seems that there are no limitations such as weight or age to proceed with the definitive surgery. Also, the incidence of complications is independent of the type of anomaly or approaches for closing the defect. Finally, BT shunt has its own complications which are neither rare nor minor, so it is advisable to proceed with the definitive surgery at the first time to avoid the complications associated with BT shunt.

Reviewing the literature, it seems prudent to divide BT shunts at the time of corrective surgery to avoid pulmonary artery distortion with growth. Also one can probably suture the lower margin of the ventricular septal defect in the beating heart to avoid heart block.

Conflict of Interest

No conflicts of interest have been claimed by the authors.

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