Surgical treatment for patients with complete atrioventricular block after device closure of perimembranous ventricular septal defects

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Postoperative complete atrioventricular block (CAVB) rarely occurs but cannot be completely avoided with device closure. Here we report our experiences with the treatment of early postoperative CAVB.

CLINICAL SUMMARY

From April 2010 to March 2014, a total of 893 patients with perimembranous ventricular septal defects (VSDs) successfully underwent pericardiac device closure at our hospital. Four patients had CAVB occur during the early postoperative period (<7 days). Two patients had Adams-Stokes syndrome develop, 1 at postoperative hour 50 and 1 on postoperative day 7. Both patients were unconscious and convulsing. In addition, electrocardiography revealed CAVB with pathologic pauses (as long as 15 seconds in patient 1 and 12 seconds in patient 2). Patient 3 was seen with convulsions and tachypnea on postoperative day 3; Mobitz type II atrioventricular block with a heart rate of approximately 48 beats/min was revealed by electrocardiography. CAVB occurred in patient 4 at postoperative hour 37 without any symptoms.

We performed emergency surgery to remove the occluder and repair the VSD in these 4 patients. We opened and expanded the original incision to the suprasternal fossae. We then established cardiopulmonary bypass and located the occluder through the right atria incision. Next, we removed the occluder with a delivery system. We then repaired the VSD with a patch or interrupted mattress sutures. Temporary extraepicardial pacemakers were implanted in all patients, because the arrhythmias remained evident after surgery.

TABLE 1. Characteristics of patients with atrioventricular block (n = 4)

Sex (male/female)	3:1
Mean age (y)	4.98 ± 2.18
Mean weight (kg)	21.75 ± 7.63
VSD diameter (mm)	4.50 ± 2.38
Occluder diameter (mm)	6.75 ± 0.95
Membranous aneurysm VSD (no.)	2
Perimembranous VSD (no.)	2
Time of arrhythmia (h)*	81.5 ± 59.54
Time of AVB reversal (h)†	1.88 ± 0.25

Values are presented as mean ± SD except as noted. VSD, Ventricular septal defect; AVB, atrioventricular block. *After occlusion. †After emergency surgery.

All patients resumed sinus rhythm within 2 hours of emergency surgery and were discharged 6 days later. Electrocardiographic evaluation at discharge revealed incomplete right bundle branch blocks in patients 1 and 3, a left anterior hemiblock and incomplete right bundle branch block in patient 2, and a ventricular premature beat with a left bundle branch block in patient 4. More detailed patient information is provided in Table 1. Sinus rhythm was observed in all 4 patients, but the same results detected at discharge were also detected during our follow-up period, which ranged from 1 month to 3 years.

DISCUSSION

The exact mechanism underlying postoperative CAVB remains unclear despite various hypotheses. In this cohort, oversized occluders were implicated in postoperative CAVB in 2 patients. In patients 3 and 4, the VSDs were detected as supracristal defects (a special type of perimembranous defect).¹ In that subgroup, the margins of the supracristal defects were formed by fibrous continuity with the tricuspid valve. The leaflets of the aortic valve are still likely to prolapse with this combination, but the conduction tissue has a greater intraoperative risk because it is unprotected by the buttressing bar.

After intervention, the traditional treatment for CAVB involves high-dose steroids. Interventional cardiologists have also reported the successful use of steroids to treat atrioventricular block after percutaneous transcatheter closure of a VSD.^{2,3} Unfortunately, in some patients, cardiac rhythms are not restored to normal and return to CAVB.^{4,5} We disagree, however, with the traditional strategy of treating CAVB with interventional therapy. We believe that a positive perspective should be maintained with respect to treatment

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by postoperative CAVB associated with interventional therapy. As mentioned previously, our results indicate that removing the device instead of pursuing conservative treatment can return the CAVB to sinus rhythm immediately or shortly after heart surgery and can prevent recurrence of CAVB.

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EDITORIAL COMMENTARY

New procedures, new complications, and new strategies to deal with them

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See related article on pages 530-1.

The importance of the report by Hu and colleagues¹ is not in the large number of patients with membranous ventricular septal defect (VSD) who have been treated with pericardiac (transthoracic) device closure of VSD by cardiac surgeons in People's Republic of China. Indeed, several Chinese series have now been published, each reporting on several hundreds of patients.² Unlike the complete atrioventricular block (CAVB) that occurs after open VSD repair, CAVB after device closure of VSD typically occurs in a delayed fashion, often days after the procedure. At that point, patients are likely to have been discharged and are unmonitored at home. This situation can easily be lethal. This delayed occurrence is the reason that the incidence of CAVB that occurs after device closure of VSD might be underreported, and it is the main reason the US Food and Drug Administration has not allowed device closure of membranous VSD in the United States.

These findings notwithstanding, the significance of this report lies in the fact that the authors took every patient diagnosed with CAVB back to surgery and removed the device and closed the VSD in a traditional manner. All patients recovered to normal sinus rhythm. New procedures, such as device closure of membranous VSD, often result in new, previously unseen complications, and this then leads to the need to develop new management strategies. Indeed, I believe the authors have shown that whenever CAVB occurs after percutaneous or pericardiac device closure of VSD, the correct treatment is now to proceed to open heart repair with device removal.

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