CLINICS

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Percutaneous closure of traumatic ventricular septal defects: device selection and reasoning

Jian Zhu, Er-Ping Xi, Shui-Bo Zhu*

Wuhan General Hospital of Guangzhou Command, Department of Thoracic Cardiovascular Surgery, Wuhan, 430070, Hubei Province, People's Republic of China.

Email: zhudandan2008@163.com
Tel.: 86-13871161122
*corresponding author

Dear Editors,

A ventricular septal defect (VSD) is one or more holes in the wall that separates the right and left ventricles of the heart. VSD is one of the most common congenital (present from birth) heart defects. Many types of VSDs have been reported, including congenital VSDs, post-infarction VSDs (1), and post-traumatic VSDs (2). Furthermore, there are four types of congenital VSDs; perimembranous VSD is the most common, while outlet, atrioventricular, and muscular VSDs are less common (3). VSDs vary in size, number, and location within the interventricular septum, and their clinical implications often depend on these factors.

Childhood mortality has continuously decreased in recent decades, and mortality has shifted almost entirely to adulthood as a result of both conservative and surgical treatments (4). Small congenital VSDs often close on their own as the heart grows, and such patients may be treated conservatively (5). However, some patients may require surgical intervention. Percutaneous closure of VSDs has emerged as a good alternative to address important and difficult cardiac surgical problems and prevent issues related to cardiopulmonary bypass in selected patients (2). The most important issue prior to percutaneous closure is to decide whether the defect can be closed via a percutaneous approach and which device should be chosen.

Various devices that have been used for VSD closure have been reported in previous articles. These devices include amplatzer® VSD Occluder, atrial septal defect (ASD) Occluder, and patent ductus arteriosus (PDA) Occluder (2,6,7). However, there is no clear consensus on device selection (8). The investigators present their experience with choosing devices for percutaneous VSD closure in this paper.

The main factor in choosing a device is the length of the occluder's waist. The Amplatzer Muscular VSD Occluder and ASD Occluder are designed for congenital heart disease, and congenital VSDs are uniformly straight and short. Therefore, the length of occluder's waist is limited to approximately 4 mm. This device is also suitable for post-infarction VSDs and other straight and short VSDs (6,7). Post-traumatic VSDs, as described by Xi EP, Zhu J, Zhu SB and their colleagues, are angled (2). The length of this type of VSD is typically longer, frequently more than 9 mm. Therefore, the Amplatzer Muscular VSD Occluder and ASD Occluder are not appropriate.

The use of the PDA Occluder for post-traumatic VSD closure suggested a new way of approaching treatment for the closure of different types of VSDs and provided a new standard for the design of occlusion devices. The use of the PDA Occluder for VSD closure has several advantages compared with the Amplatzer Muscular VSD Occluder and the ASD Occluder. First, if the right-sided opening of the VSD is near the right ventricular outflow tract, the right disc may obstruct the ventricular outflow tract when VSD or ASD Occluders are used. The PDA Occluder cannot cause ventricular outflow tract obstruction because it only has a left disc; furthermore, this single disc reduces the cost of the closure device. In addition, the metal waist of a PDA Occluder is both more flexible and softer than other occluder implants, so it is more easily released and molded. The implant also moves in synchrony with the heartbeat. Fatigue damage to an occluder's metal material (9) occurs under the action of the dynamic load, and an implant's main cause of failure is fatigue rupture. This type of rupture is more likely to occur in occluders that have two discs and a very narrow waist, which are more likely to experience fatigue rupture because of the loads on the two discs.

Based on our limited experience and a lower observed morbidity rate, our view is detailed below. The use of PDA Occluder devices for percutaneous closure of post-traumatic VSDs is feasible, safe and effective. This method could allow all types of VSDs to be closed via a percutaneous approach. Furthermore, the use of a PDA Occluder provides a new standard for the design of occluder devices. However, in the absence of larger studies comparing surgical options, observational management and skillful clinical intervention, and most clinicians have more clinical experience using these devices, we suggest continuing to use a VSD Occluder or ASD Occluder in general VSD cases for routine repair for a longer experience on clinical application. But due to different types of VSD, different options of the device should be taken to solve them.

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