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Original article

Percutaneous closure of postinfarct muscular ventricular septal defects: A multicenter study in China

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ABSTRACT

Background: Surgical repair is an effective method to treat ventricular septal defect (VSD) complicating acute myocardial infarction (AMI). However, the mortality rate remains high. This study was designed to assess the immediate and mid-term results of transcatheter closure of postinfarct muscular VSDs.
Methods: Data were retrospectively collected from 42 AMI patients who underwent attempted transcatheter VSD closure between 2008 and 2012 in seven heart centers of China.
Results: Nine patients underwent emergent VSD closure in the acute phase (within two weeks from VSD) while the others underwent elective closure. The time between VSD occurrence and closure in emergency group and elective group was 7.7 ± 2.3 days and 35 ± 14.5 days, respectively ($p < 0.01$). The percentage of procedure success in the emergency group and elective group was 77.8% (7/9) and 97% (32/33), respectively ($p = 0.048$). The hospital mortality was higher for emergent closure in comparison to elective closure (66.7% vs. 6.1%, $p < 0.01$). During a median follow-up of 25 months (0–58 months), two patients died at 8 and 29 months, respectively, and no serious complications occurred in other patients.
Conclusion: Interventional postinfarct VSD closure is a safe and effective approach that can be performed with a high procedural success rate, with favorable outcomes if it can be undertaken >14 days postinfarct.

Introduction

Ventricular septal defect (VSD) complicating acute myocardial infarction (AMI) is a rare but fatal complication, occurring in 1–3% of patients in the pre-reperfusion era [1,2]. VSD after AMI was associated with extremely poor outcome, with in-hospital mortality rates in two studies of about 42.9% ($n = 2876$) [3] and 47% ($n = 41021$) [4] for surgically treated patients and 90% for those treated medically [5,6]. With the development of reperfusion therapies such as thrombolysis and percutaneous coronary intervention (PCI), there was a significant decrease in incidence (0.2–0.5%) and mortality of postinfarction VSD [4,7]. Although this decrease is encouraging, both early and long-term prognoses after AMI-related VSD remain unsatisfactory. Surgical repair is a traditional and effective method and favorable for survival [3,8]. However, the mortality rate remains high [3,9], and the incidence of a large residual shunt and re-rupture after surgery reaches up to 10–20% [10,11]. Among the patients who survived the perioperative period the five-year survival rates reported in two studies were only 57.1% ($n = 1235$) and 38% ($n = 189$) [3,12]. With advances in cardiac interventional techniques and devices, transcatheter closure of VSD had become an alternative or a bridge to surgical

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repair for patients with postinfarction VSD, mainly as anecdotal single case reports [13] or as small series [14–17]. We evaluated the immediate- and mid-term safety and efficacy of transcatheter VSD closure in 42 cases of AMI patients with the additional complication of postinfarction VSD from seven Chinese heart centers.

Materials and methods

We conducted a retrospective chart review of all patients who underwent transcatheter closure of postinfarction VSD at seven Chinese heart centers from 2008 to 2012. Patients with congenital muscular VSD or who could not undergo closure because of too big size and other reasons were excluded. Primary data were abstracted from the electronic medical record or archived records. Demographic information was collected from the time of procedure. Transthoracic echocardiography (TTE) measurements were collected before procedure and at latest follow-up focusing on location of occluder, residual shunt, and cardiac function. Invasive hemodynamic measurements and procedural information were collected from catheterization records. All patients who survived the procedures were called to hospital for follow-up by TTE, echocardiography (ECG), and clinical examination between March and May 2013. The degree of residual shunt was assessed by measuring the width of the color jet as it exited through the ventricular septum by TTE. It was classified as trivial for a width <1 mm, mild for a width between 1 and 2 mm, moderate for a width between 2 and 4 mm, and severe for a width >4 mm. Clinical data were collected concerning patient symptoms prior to procedure and at the most recent follow-up. Furthermore, patients were identified by change in symptoms (improved/worse/no change) based upon their explicit description of significant change in symptoms as documented in the medical record. Before intervention, informed written consent was obtained from all patients or their parents. The study was approved by the Ethics Committee of Changhai Hospital, and was carried out in accordance with the Declaration of Helsinki (1996) and all relevant Chinese laws. Two types of occluders were used in the study: the Amplatzer occluder (AGA Medical, Golden Valley, MN, USA) and the domestic SHSMA occluders (Shape Memory Alloy Ltd, Shanghai, China). The SHSMA occluder used was a modified double-disk occluder, which was designed based on the Amplatzer occluder. The only difference between these two occluders is the size of the left disk and the maximum diameter of the waist. The diameter of the left disk is 14 mm larger than that of the waist in SHSMA occluder, while 10 mm larger in Amplatzer occluders. The maximum diameter of the waist is 32 mm in SHSMA occluder, while 24 mm in Amplatzer occluders. The waist length of both SHSMA and Amplatzer occluders is 10 mm (Fig. 1).

Statistical analysis

All continuous variables are expressed as mean ± standard deviation (SD) or median with range as appropriate, and discrete variables are presented as frequencies and/or percentages. Comparisons of baseline data were performed using the chi-square test or Fisher's exact test (categorical variables) and Student's *t*-test or Wilcoxon rank-sum test as appropriate (continuous variables). All tests were two-sided, and *p*-values <0.05 were considered as indicating statistical significance.

Results

Demographic data and clinical characteristics

A total of 42 patients qualified for inclusion. The mean age of patients was 65 ± 4.1 years and 43% (18/42) were female. The AMI preceding the VSD was anterior in 19 and inferior/posterior in 23 patients. At the time of presentation, cardiogenic shock was present in 16 patients (38.1%), and 18 patients (42.9%) had a history of angina. Standard comorbidities were hypertension in 29 (69%), hypercholesterolemia in 21 (50%), diabetes mellitus in 11 (26.2%), active smoking in 17 (40.1%), and history of revascularization in two (4.8%). The time from infarction to VSD occurrence was 2.5 ± 1.4 days and the time from VSD occurrence to percutaneous device closure was 29 ± 17.2 days. Demographic and clinical findings of patients are summarized in Table 1. In these patients, nine (21.4%) underwent emergent closure (within two weeks) of a post-MI VSD. All patients presenting with hypotension and heart failure were supported by intra-aortic balloon pump (IABP).

Interventional VSD closure procedure and periprocedural complications

Coronary angiography was performed prior to VSD closure in all patients with 47.6%, 33.3%, and 19.1% having single-, double-, and triple-vessel diseases. Successful device deployment was performed in 39 of the 42 patients and 34 of them survived until discharge. The VSDs were located apically in 26 patients and basally in 16 patients. Thirty-nine patients underwent successful transcatheter VSD closure including four patients with two defects and one patient with three defects each which were closed by using two separate devices except one patient with two defects was closed

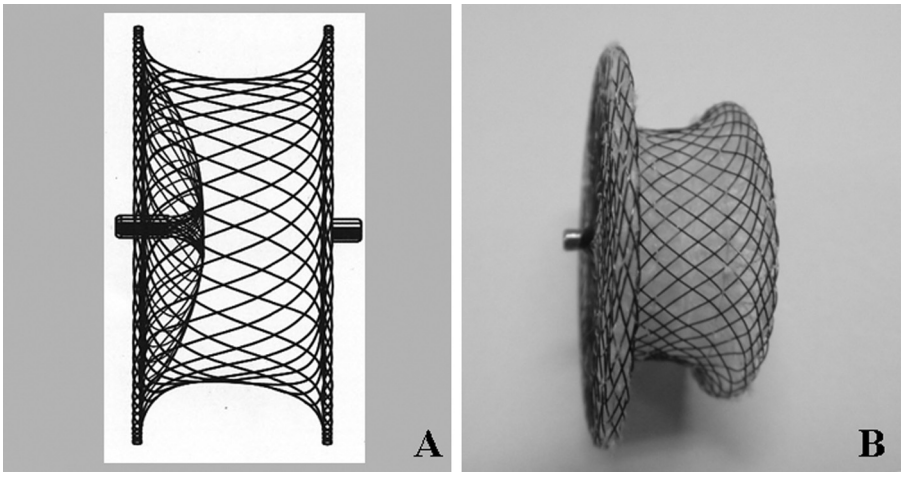

Fig. 1. Lateral views of the Amplatzer (A) and SHSMA (B) muscular ventricular septal defect occluders.