



Retrograde transcatheter closure of ventricular septal perforation after acute myocardial infarction: a case report

Wei Zhong, Zhidong Liu, Xianfang Wang, Changjing Huang, Zhixiong Zhong

Center for Cardiovascular Diseases, Meizhou People's Hospital (Huangtang Hospital, Meizhou Hospital Affiliated to Sun Yat-sen University), Meizhou, China

Correspondence to: Zhixiong Zhong. Center for Cardiovascular Diseases, Meizhou People's Hospital (Huangtang Hospital, Meizhou Hospital Affiliated to Sun Yat-sen University), Meizhou, China. Email: zhongzhixiong@mzrmmy.com.

Abstract: The use of the Lunderquist exchange guide wire via the retrograde approach of the right femoral vein-inferior vena cava-right atrium-right ventricle-ventricular septal perforation-left ventricle-descending aorta can maintain guide wire tension and significantly reduce the operative time. The patient was admitted due to chest pain for 3 hours. The diagnosis was acute anterior septal myocardial infarction with ventricular septal perforation. One week after admission, a drug-eluting stent was implanted in the left anterior descending branch. Repeated echocardiography revealed that the diameter of the ventricular septal perforation had increased from 6 to 12 mm. During this period, the patient suffered from repeated episodes of shortness of breath that were progressively exacerbated. The patient was transferred to the intensive care unit (ICU) and underwent intra-aortic balloon pump (IABP) implantation. Twenty days after admission, the Lunderquist exchange guide wire was used via the retrograde approach of the right femoral vein-inferior vena cava-right atrium-right ventricle-ventricular septal perforation-left ventricle-descending aorta. A 26-mm occluder was released for transcatheter closure of the ventricular septal perforation. Shortness of breath was immediately relieved. The patient was discharged 3 days later. Retrograde transcatheter closure of ventricular septal perforation can effectively reduce operative time and is conducive to quick and stable improvement of the patient's condition.

Keywords: Transcatheter; acute myocardial infarction (AMI); ventricular septal perforation; case report.

Submitted Apr 20, 2020. Accepted for publication Jun 04, 2020.

doi: 10.21037/atm-20-4014

View this article at: <http://dx.doi.org/10.21037/atm-20-4014>

Introduction

Ventricular septal perforation is a rare but a serious complication of acute myocardial infarction (AMI), and it has high mortality. Without effective treatment, the 1-month mortality rate exceeds 50%, and the 3-month survival rate does not exceed 10% (1). Both surgical procedures and transcatheter closure can effectively treat ventricular septal perforation. The short-term and long-term prognosis after surgery are similar, but interventional surgery is more convenient (2,3). The traditional approach used for interventional surgery is from the left femoral artery through the perforation of the interventricular septum to the right femoral vein. This approach is long

and tortuous and requires the use of loach guidewires, which may cause myocardial damage due to their insufficient tension and difficult placement through the delivery sheath (4). In this case, we performed retrograde transcatheter closure of the ventricular septal perforation. A 26-mm occluder was successfully placed to close the ventricular septal muscular perforation. Left ventricular angiography showed only a small amount of residual shunting immediately after surgery. The approach used for the delivery system is as follows: right femoral vein-inferior vena cava-right atrium-right ventricle-ventricular septal perforation-left ventricle-descending aorta. The Lunderquist exchange guidewire was introduced to allow entry of the delivery sheath with sufficient tension. The

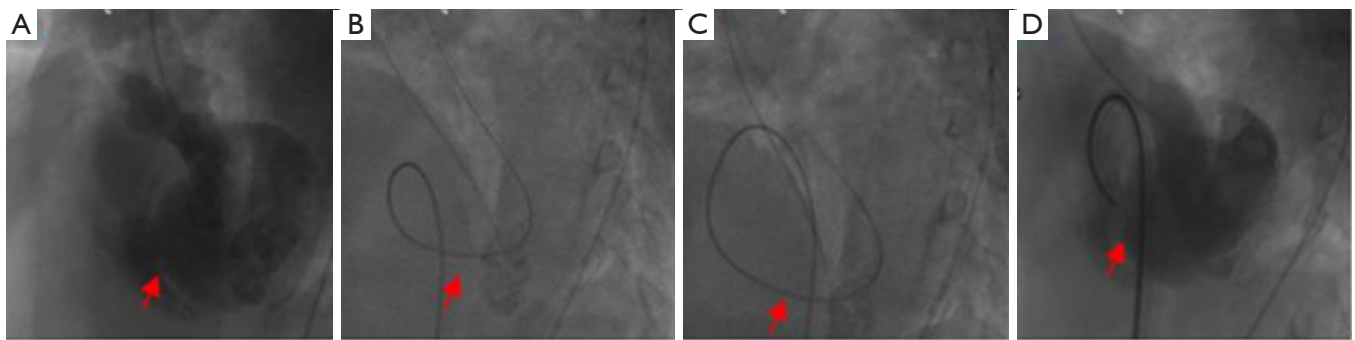


Figure 1 Procedure of retrograde transcatheter closure of ventricular septal perforation after myocardial infarction. (A) Left ventricular angiography shows a ventricular septal perforation 12 mm in diameter, red arrow: position of perforation; (B) the loach guide wire passes through the right ventricle via the perforation to reach the ascending aorta, red arrow: guide wire in aorta through perforation; (C) the Lunderquist exchange guide wire is introduced along the MP catheter to create a retrograde delivery system, red arrow: Lunderquist wire run through perforation by MP guidance sheath; (D) successful closure and angiography showing a small amount of residual shunting, red arrow: perforation has been closed.

procedure went smoothly, and the duration of the operation was 56 minutes, which is significantly shorter than the average operative time of 100 minutes in the past (4).

We present the following case in accordance with the CARE reporting checklist (available at <http://dx.doi.org/10.21037/atm-20-4014>).

Case presentation

A 68-year-old woman was admitted to the hospital on September 23, 2019, due to chest pain for 3 hours and was diagnosed with AMI. She had a history of hypertension for 11 years; the highest blood pressure reading was 204/116 mmHg. She was on long-term treatment with amlodipine (5 mg, qd), benazepril (10 mg, qd), and atorvastatin (20 mg, qd). Her blood pressure was controlled at 140/80 mmHg.

Clinical findings

The patient's blood pressure was 110/60 mmHg on admission. A III/6 systolic murmur was audible at the left sternal border in the 3–4 intercostal space. Electrocardiogram showed acute anterior myocardial infarction, and bedside ultrasound showed ventricular septal perforation. Her lab test showed a cardiac troponin T (cTnT) level of 17.9 µg/L and an N-terminal pro b-type natriuretic peptide (NT-proBNP) level of 1,492.5 µg/L.

Timeline

On September 23, 2019, the patient was admitted to the coronary care unit (CCU) due to chest pain for 3 hours and was diagnosed with AMI. The bedside cardiac ultrasound showed ventricular septum perforation (6 mm in diameter).

On September 30, 2019, she was in stable condition. Coronary angiography showed severe stenosis in the middle segment of the left anterior descending branch. A drug-eluting stent was implanted. Bedside color Doppler ultrasound showed interventricular septal perforation (8 mm in diameter).

On October 10, 2019, the patient complained of shortness of breath with even slight movements at the bedside, and bedside color Doppler ultrasound indicated a ventricular septal perforation with a diameter of 12 mm.

On October 17, 2019, the patient's shortness of breath worsened, and a V/6 systolic murmur was audible at the left sternal border in the 3–4 intercostal space. Her blood pressure was 90/50 mmHg. An IABP was implanted after she was transferred to the intensive care unit.

On October 18, 2019, we performed retrograde transcatheter closure of the ventricular septal perforation under local anesthesia. A 26-mm occluder was successfully placed to close the ventricular septal muscle perforation. Left ventricular angiography immediately after surgery showed only a small amount of residual shunting (*Figure 1*). The patient's condition improved after surgery, and she was

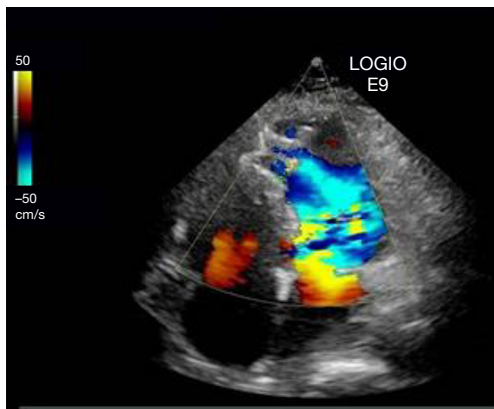


Figure 2 Echocardiography at 2019.10 showed the perforation.

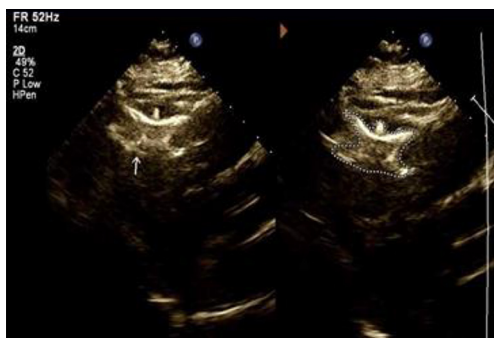


Figure 3 Echocardiography at 2020.01 showed that the occluder was well positioned and secure.

discharged.

Diagnostic assessment

After admission, the patient's cTnT level gradually increased to a maximum of 29.7 $\mu\text{g/L}$ on October 8, 2019, and her NT-proBNP level gradually increased to a maximum of 11,038.6 $\mu\text{g/L}$ on October 17, 2019. Auscultation showed a gradually increasing grade of systolic rough murmurs in the left sternal border in the 3–4 intercostal space. Color Doppler ultrasound indicated gradual enlargement of the ventricular septal perforation. Based on the above-presented findings, the diagnosis was confirmed: (I) acute anterior septal myocardial infarction with ventricular septal perforation; and (II) hypertension grade; (III) the patient was at extremely high risk, and her prognosis was considered extremely poor.

Therapeutic intervention

After admission, aspirin (100 mg, qd), clopidogrel (75 mg/qd) and low molecular weight heparin (5,000 U, twice a day) were administered for anticoagulation according to guidelines, and the regimen was adjusted according to the patient's blood pressure level. On October 18, 2019, we performed retrograde transcatheter closure of the ventricular septal perforation. A 26-mm occluder was successfully placed to close the ventricular septal muscle perforation. Left ventricular angiography showed only a small amount of residual shunting immediately after surgery. The delivery system used the following approach: right femoral vein-inferior vena cava-right atrium-right ventricle-ventricular septal perforation-left ventricle-descending aorta. The Lunderquist exchange guide wire was introduced with sufficient tension when entering the delivery sheath. The operation was successful. The operation time was 56 minutes, which was significantly shorter than the average operation time of 100 minutes in the past (*Figure 2*).

Follow-up

On January 18, 2020, the patient returned to the hospital for a follow-up examination. She had no complaints. Echocardiography indicated that the occluder was well positioned and secure, and a residual shunt (2 mm in diameter) at the upper edge of the occluder was noted (*Figure 3*). The electrocardiogram showed old anterior wall myocardial infarction. Both the cTnT and NT-proBNP levels were within normal limits, and the patient's blood pressure was 124/68 mmHg. She was instructed to continue using aspirin (100 mg, once a day), clopidogrel (75 mg/once a day), benazepril (10 mg, once a day) and atorvastatin (40 mg, once a day). No major adverse cardiovascular events (MACEs) were reported during the follow-up period.

Discussion

Ventricular septal rupture (VSR) is a rare and catastrophic mechanical complication after AMI, with an incidence of approximately 0.3% to 0.5% (5,6). Surgery has a definite effect on some patients, but postoperative mortality is still high (7). To date, transcatheter device closure has become an effective method for the treatment of VSR due to its minimal invasiveness and safety (8). The key to the

success of the operation is to create a delivery system. The traditional delivery system used in interventional surgery enters at the left femoral artery and progresses through the interventricular septum perforation to the right femoral vein. This approach is long and tortuous and requires the use of loach guidewires, which may cause myocardial damage due to their insufficient tension and difficulty of placement through the delivery sheath (4,9). In this patient, we attempted to use the retrograde transcatheter closure technique, that is, we used the loach guidewire inserted from the right ventricle to the descending aorta through the ventricular septal perforation. The delivery system took the following approach: right femoral vein-inferior vena cava-right atrium-right ventricle-ventricular septal perforation-left ventricle-descending aorta. The Lunderquist exchange guidewire was introduced to allow entry into the delivery sheath with sufficient tension. The procedure went smoothly, and the duration of the operation was 56 minutes, which is significantly shorter than the average operation time of 100 minutes in the past. This technique is beneficial for restoring hemodynamic stability as quickly as possible. In summary, retrograde transcatheter closure is a feasible procedure for closing interventricular septal perforations. This procedure simplifies the previous steps involved in capturing the guidewire and creating the delivery system. It reduces the risk of the guidewire entering the tricuspid tendon, enhances the tension of the guidewire, and reduces the risk and operation time. The procedure is simpler and safer than previous methods, and its application is easier to extend.

Patient perspective

The patient complained of shortness of breath and chest tightness after admission. Upon examination, the physician found that the perforation of the interventricular septum had gradually increased. After the patient's condition deteriorated, the physician placed an IABP in a timely manner and then performed retrograde transcatheter closure of the ventricular septal perforation. The patient's symptoms were noticeably relieved immediately after surgery.

Acknowledgments

Funding: None.

Footnote

Reporting Checklist: The authors have completed the CARE reporting checklist. Available at <http://dx.doi.org/10.21037/atm-20-4014>

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at <http://dx.doi.org/10.21037/atm-20-4014>). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). Written informed consent was obtained from the patient for publication of this manuscript and any accompanying images.

Open Access Statement: This is an Open Access article distributed in accordance with the Creative Commons Attribution-NonCommercial-NoDerivs 4.0 International License (CC BY-NC-ND 4.0), which permits the non-commercial replication and distribution of the article with the strict proviso that no changes or edits are made and the original work is properly cited (including links to both the formal publication through the relevant DOI and the license). See: <https://creativecommons.org/licenses/by-nc-nd/4.0/>.

References

1. Goldsweig AM, Wang Y, Forrest JK, et al. Ventricular septal rupture complicating acute myocardial infarction: Incidence, treatment, and outcomes among medicare beneficiaries 1999-2014. *Catheter Cardiovasc Interv* 2018;92:1104-15.
2. Takahashi H, Arif R, Almashoor A, et al. Long-term results after surgical treatment of postinfarction ventricular septal rupture. *Eur J Cardiothorac Surg* 2015;47:720-4.
3. Yam N, Au TW, Cheng LC. Post-infarction ventricular septal defect: surgical outcomes in the last decade. *Asian Cardiovasc Thorac Ann* 2013;21:539-45.
4. Sabiniewicz R, Huczek Z, Zbroński K, et al. Percutaneous Closure of Post-Infarction Ventricular Septal Defects- An Over Decade-long Experience. *J Interv Cardiol*

- 2017;30:63-71.
5. Jones BM, Kapadia SR, Smedira NG, et al. Ventricular septal rupture complicating acute myocardial infarction: a contemporary review. *Eur Heart J* 2014;35:2060-8.
 6. Ng R, Yeghiazarians Y. Post myocardial infarction cardiogenic shock: a review of current therapies. *J Intensive Care Med* 2013;28:151-65.
 7. Wilson WM1, Horlick EM. Management of post-myocardial infarction ventricular septal rupture. *EuroIntervention* 2016;12 Suppl X:X18-X23.
 8. Zhong W, Liu Z, Fan W, et al. Cardiac MRI-guided interventional occlusion of ventricular septal rupture in a patient with cobalt alloy stent. *Ann Transl Med* 2019;7:395.
 9. Tai S, Tang JJ, Tang L, et al. Management and outcome of ventricular septal rupture complicating acute myocardial infarction: what is new in the era of percutaneous intervention? *Cardiology* 2018;141:226-32.

Cite this article as: Zhong W, Liu Z, Wang X, Huang C, Zhong Z. Retrograde transcatheter closure of ventricular septal perforation after acute myocardial infarction: a case report. *Ann Transl Med* 2020;8(12):769. doi: 10.21037/atm-20-4014