CASE REPORT
Yeungnam Univ J Med 2014;31(1):28-32

pISSN 1225-7737/eISSN 2234-8042
http://dx.doi.org/10.12701/yujm.2014.31.1.28

Treatment of pulmonary thromboembolism using Arrow-Trerotola percutaneous thrombolytic device

Tae Kyun Kim[1], Ji Young Park[1], Jun Ho Bae[1], Jae Woong Choi[1], Sung Kee Ryu[1], Min-Jung Kim[1], Jun Bong Kim[1], Jang Won Sohn[2]

[1]Department of Cardiology, Eulji General Hospital, Eulji University, Seoul; [2]Division of Cardiology, Department of Internal Medicine, College of Medicine, Yeungnam University, Daegu, Korea

Pulmonary thromboembolism (PTE) increases the pressure of the right ventricle and leads to symptoms and signs, such as dyspnea and hypoxia. If PTE causes hemodynamic instability, thrombolytic therapy should be considered. A mechanical thrombectomy is an alternative treatment to thrombolytic therapy and should be considered when thrombolytic therapy is contraindicated. Various devices are used in mechanical maceration and catheter-directed thrombolysis, but there is no standard mechanical device for PTE as yet. We report here on 2 clinical experiences of mechanical thrombectomy using the Arrow-Trerotola percutaneous thrombolytic device to remove residual clots after systemic thrombolysis in patients with massive PTE.

Keywords: Pulmonary embolism; Mechanical thrombectomy; Trerotola

INTRODUCTION

Pulmonary thromboembolism (PTE) most commonly occurs due to venous thromboembolism (VTE) occuring in the deep veins in the legs, causing a partial or complete occlusion of the pulmonary vasculature. The incidence of VTE is approximately 5 times higher in pregnant women due to increased venous stasis, and VTE is more likely to develope in patients with protein C or S deficiency. When PTE is strongly suspected, immediate treatment is required. Especially in the patients with persistent PTE, in spite of treatment with a thrombolytic agent such as urokinase, catheter intervention offers an alternative treatment to systemic thrombolysis [1]. We report on 2 cases of massive PTE, who were treated with mechanical thrombectomy using an Arrow-Trerotola percutaneous thrombolytic device (PTD; Arrow, Reading, PA, USA) (Fig. 1) to remove residual clots after systemic thrombolysis.

Received: June 24, 2013; Revised: August 20, 2013; Accepted: August 27, 2013

Corresponding Author: Ji Young Park, Department of Cardiology, Eulji General Hospital, Eulji University, 14 Hangeolbiseok-Gil, Nowon-gu, Seoul 139-872, Korea
Tel: +82-2-970-8620, Fax: +82-2-970-8887
E-mail: cisamoe@gmail.com

CASES

CASE 1

A 31-year-old woman was admitted to the emergency room for sudden shortness of breath that had occurred the day before. She had undergone a caesarian section 2 days before, and she had no past medical history of diabetes, hypertension, or smoking.

On physical examination, her blood pressure was 90/60 mm Hg, pulse rate was 110 beats per minute, respiratory rate was 20 breaths per minute. Temperature was 37.0℃, and O_2 saturation was 92% with facial mask (8 liter/min), and cardiac biomarkers were elevated (creatine kinase [CK]-MB:

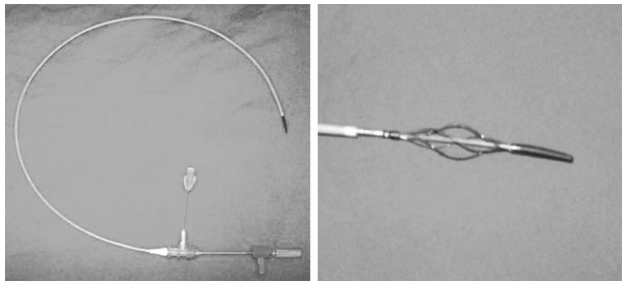

Fig. 1. Arrow-Trerotola percutaneous thrombolytic device.

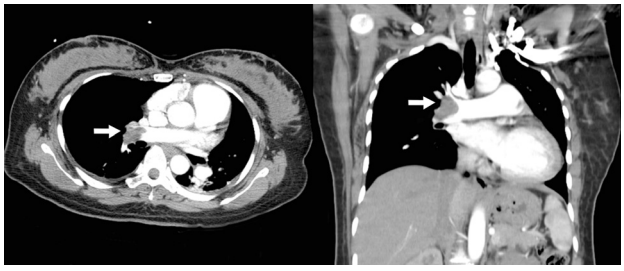

Fig. 2. Heart aorta pulmonary enhanced computed tomography showed filling defect in the pulmonary arteries of the right middle lobe. Arrow indicated a pulmonary thromboembolism.

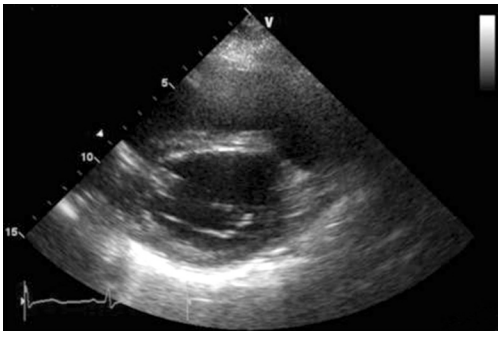

Fig. 3. Echocardiography showed enlarged right ventricle and slightly D-shape of left ventricular septum.

6.43 ng/mL). Breathing sounds were clear, and heart sounds were regular without murmur. In routine laboratory tests, white blood cells were found to be increased to 15,140/μL, and D-dimer was increased to 5.3 μg/mL. Coagulation profile including prothrombin time, activated partial thromboplastin time, and international normalized ratio (INR) were within normal ranges. Pulmonary enhanced computed tomography (CT) showed PTE in pulmonary arteries of the bilateral upper lobe, right middle lobe, and right basal anterior and posterior lobes (Fig. 2). Echocardiography showed an enlarged right ventricle and atrium, increased pulmonary arterial pressure (PAP, 88 mm Hg), reduced left ventricular (LV) ejection function (LVEF, 46%), and a slightly D-shape left ventricle (Fig. 3). Ultrasound doppler sonography of the lower extremity showed acute deep vein thrombosis (DVT) involving both popliteal vein and calf veins. The patient was diagnosed with massive PTE and considered to be a high risk patient due to the combination of right ventricular (RV) hypokinesia and elevated cardiac biomarkers.

Thrombolysis was performed using urokinase 1,200,000 IU for reducing massive PTE. After infusion, pulmonary angiography showed that thrombus was decreased. After systemic thrombolysis, dyspnea and hypoxia remained. Follow up echocardiography showed a reduced LV ejection fraction (50%), increased PAP (63 mm Hg), and D-shape of the left ventricle. The patient had undergone a caesarian section 2 days earlier, and additional systemic thrombolysis was contraindicated due to the patient's high risk for bleeding. Therefore, we considered mechanical thrombectomy as an alternative to systemic thrombolysis. We performed pulmonary angiography which showed a large thrombus in the distal part of the right main pulmonary artery. We inserted an inferior vena cava (IVC) filter, and performed mechanical thrombectomy using an Arrow-Trerotola PTD (Fig. 4). After the procedure however, subfascial hematoma occurred in the puncture site. After thrombectomy using Arrow-Trerotola PTD, echocardiography showed a normal sized right ventricle and disappearance of the D-shape in the left ventricle. Her symptoms improved, and after discharge, anticoagualtion the- rapy was performed using warfarin.

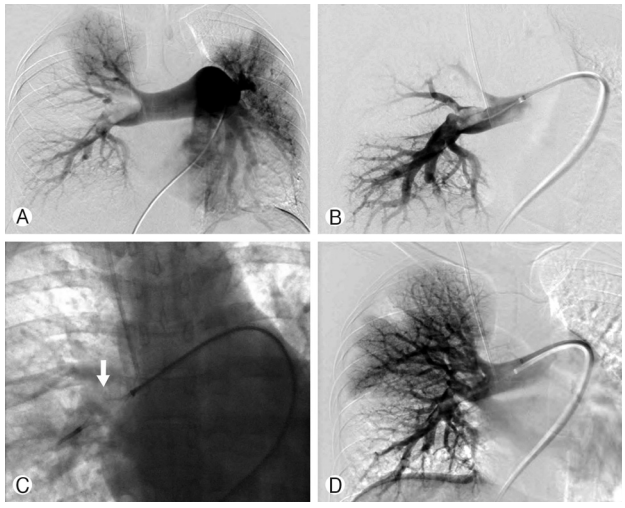

Fig. 4. Percutaneous transluminal angiographic finding (A, B). Aarrow indicated Arrow-Trerotola percutaneous thrombolytic device which was placed to the pulmonary artery for the thromboembolectomy (C). After thromboembolectomy, thromboembolism at pulmonary artery was resolved (D).

CASE 2

A 37-year-old man was admitted to the outpatient office presenting with respiratory discomfort occuring during exercise with an onset of one month prior to admission. He had

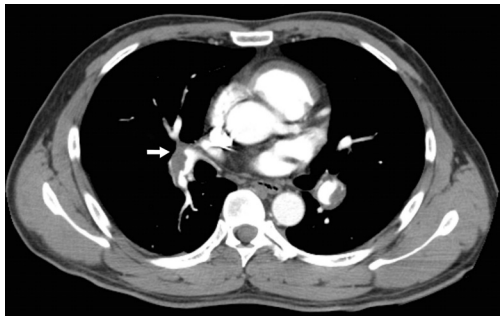

Fig. 5. Heart aorta pulmonary enhanced computed tomography showed filling defect in the both pulmonary arteries. Arrow indicated a pulmonary thromboembolism.

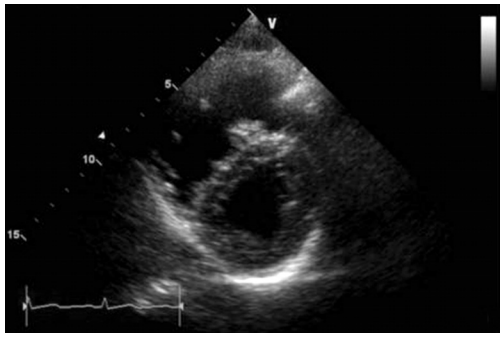

Fig. 6. Echocardiography showed enlarged right ventricle and slightly D-shape of left ventricular septum.

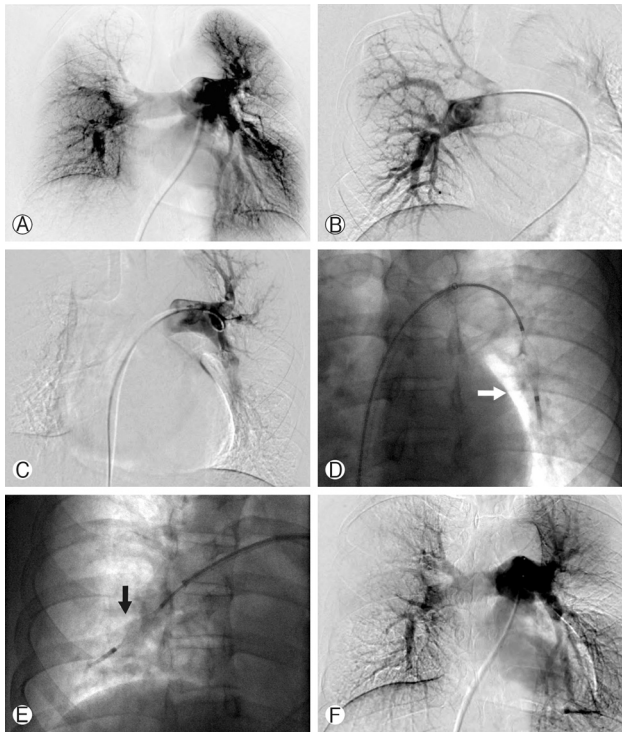

Fig. 7. Percutaneous transluminal angiographic finding (A-C). Arrow indicated Arrow-Trerotola percutaneous thrombolytic device which was placed to the pulmonary artery for the thromboembolectomy (D, E). After thromboembolectomy, thromboembolism at pulmonary artery was resolved (F).

been hospitalized for the management of PTE a year earlier, and had received anticoagulation therapy with warfarin. His follow-up INR was between 2.0 and 3.0. He had no history of diabetes mellitus or hypertension. However, he had a smoking history of 20 pack years and had stopped smoking a year earlier.

On physical examination, his blood pressure was 90/50 mm Hg, pulse rate was 98 beats per minute, and respiratory rate was 18 breaths per minute. Temperature was 36.6℃, and O_2 saturation was 95% with facial mask (5 liter/min), and cardiac markers were elevated (CK-MB: 5.88 ng/mL). His breathing sounds were clear, and heart sounds were regular without murmur. In routine laboratory tests, white blood cells showed increased levels at 6,670/μL, D-dimer had increased to 0.7 μg/mL, PT was 22.7 sec, and INR was 2.33. Heart aorta pulmonary enhanced CT showed persistent chronic PTE in both distal pulmonary arteries, both interlobar arteries, both upper lobar arteries, and both right and middle lobar arteries (Fig. 5). Echocardiography showed enlargement of the right atrium and ventricle, increased PAP (76 mm Hg), reduced LVEF (51%), and slight D-shape of the LV septum (Fig. 6). Ultrasound doppler sonography of the lower extremities showed focal DVT from mid to distal left superficial femoral vein. The patient was diagnosed with massive PTE and classified as high risk due to the combination of RV hypokinesia and elevated cardiac biomarkers. We decided to treat with thrombolysis using urokinase 700,000 IU to reduce the chronic PTE. However, after systemic thrombolysis, dyspnea and hypoxia remained, and the patient presented with hemoptysis. A follow-up chest enhanced CT showed that thrombus remained in the right, as well as the left upper and lower pulmonary arteries. Therefore, mechanical thrombectomy was considered as an alternative to systemic thrombolysis because of the patient's high risk of bleeding. After inserting an IVC filter (Fig. 7), we performed mechanical thrombectomy using Arrow-Trerotola PTD. Following that, echocardiography showed a normal sized right ventricle and disappearance of the D-shape in the left ventricle. His symptoms had improved.

DISCUSSION

Massive PTE can lead to hemodynamic instability [1]. Once massive PTE is suspected, a proper diagnostic plan with proper anticoagulation is essential [1]. Thrombolytic therapy is a valuable option in case of life-threatening pulmonary embolism [2]. Before thrombolytic therapy, bleeding risk factors should be carefully considered.

The American College of Chest Physicians (ACCP) suggests using systemic thrombolytics to treat patients with acute PTE who are hypotensive (with a cutoff of systolic blood pressure less than 90 mm Hg) (grade 2C). However, for most patients with acute PTE without hypotension, the ACCP advises against treatment with systemic thrombolytics (grade 1C) [3]. On the other hand, patients deemed to be at high risk for becoming hypotensive are recommended to receive systemic thrombolytics, if they have a low bleeding risk (grade 2C). In the 2 cases reported here, the patients were diagnosed with massive PTE (classified) as high risk due to the combination of RV hypokinesia, elevated cardiac biomarkers, and systemic thrombolysis was performed.

Catheter-assisted pulmonary embolectomy is a pharmacomechanical therapy combining mechanical thrombus disruption and aspiration with pharmacological thrombolysis, which is usually indicated in massive or submassive PTE with shock and/or RV failure. If the patient has a high risk for bleeding, or the thrombus remains after thrombolysis using sufficient thrombolytic agent, catheter intervention should be considered as an alternative treatment to systemic thrombolysis [1].

In case 1, after systemic thrombolysis, dyspnea and hypoxia persisted follow-up echocardiography showed a reduced LV ejection fraction (50%), increased PAP (63 mm Hg), and a D-shaped left ventricle. The patient had undergone a caesarian section 2 days earlier, and additional systemic thrombolysis was contraindicated because of the patient's high risk for bleeding. Therefore, we considered mechanical thrombectomy as alternative to systemic thrombolysis. In case 2, after systemic thrombolysis, dyspnea and hypoxia persisted, and the patients presented with hemoptysis. Follow-up chest enhanced CT showed that thrombus of the left lower pulmonary, the left upper pulmonary, and the right artery remained. Therefore, mechanical thrombectomy could be considered an appropriate alternative to systemic thrombolysis particularly with a high bleeding risk. Mechanical thrombectomy is a current alternative to thrombolytic therapy or surgical embolectomy. Various devices are used in mechanical maceration and catheter-directed thrombolysis including the pigtail catheter, balloon angioplasty, the rheolytic thrombectomy catheter (RTC; AngioJet, Possis Medical, Minneapolis, MN, USA) [4]. Pigtail catheters are convenient for accessing the main circulation, but they are more successful when the clot is fresh. The rotating pigtail has wide availability and lower cost compared with other devices [5]. Balloon angioplasty can allow the rapid fragmentation of the thrombus and has more effect on the chronic blood clot [6]. The RTC has been used successfully to treat massive PTE, but it takes a long time to remove the PTE and requires large amounts of saline for aspiration.

In the cases reported here, we used the Arrow-Trerotola PTD in the patients with massive PTE. Arrow-Trerotola PTD is mechanical thrombolytic device with a fragmentation basket mainly used for dialysis access products [7,8]. Previous studies have demonstrated the effectiveness of the mechanical thrombolytic device in native arteriovenous fistulas and synthetic vein grafts [9]. The safety of Arrow-Trerotola PTD in canine vein valves or in PTE of animal models has been reported in previous studies [10,11]. Rocek et al. reported on the safety and efficacy of Arrow-Trerotola PTD in mechanical fragmentation of massive pulmonary embolisms in humans [12], but cases of arterial thrombectomy using Arrow-Trerotola PTD have been rare.

In order to successful use of Arrow-Trerotola PTD in an symptomatic patient with arterial embolization, an embolectomy catheter should be placed in an artery proximal to the anastomosis. After the balloon expands, backbleeding from the distal artery should be allowed to carry the embolus back into the graft, and an over-the-wire balloon should be used to mobilize the embolus, and thromboaspiration is performed. If mechanical thrombectomy fails, thrombolysis or surgical thrombectomy can be considered [13].

Mechanical thrombectomy can be considered in the patient with recurrent thrombosis despite taking sufficient warfarin. In case 2, the patient was taking warfarin to prevent PTE, and INR was above level 2. Nevertheless, PTE recurred, and more aggressive treatment was performed using mechanical thrombectomy [14]. Because in both cases, Arrow-Trerotola PTD was used after systemic thrombolysis, it is not clear how much the catheter thrombectomy itself improved circulatory

status and contributed to the outcome. However, in both cases, we assumed that catheter-assisted pulmonary embolectomy using Arrow-Trerotola PTD can be an alternative choice in a patient with massive PTE for the removal of residual clots after systemic thrombolysis with urokinase or in a patient with chronic PTE taking warfarin following systemic thrombolysis to remove the remaining clots with symptomatic improvement. However, there are still not many cases using Arrow-Trerotola PTD in patients with PTE, and a large scale randomized control study should be performed for stability of the Arrow-Trerotola PTD procedure in the future. So that catheter intervention can be exploited as an alternative treatment of systemic thrombolysis in the patient at higher risk of bleeding or to treat recurrent thromboembolism after thrombolysis.

REFERENCES

1. Tapson VF. Acute pulmonary embolism. N Engl J Med 2008; 358:1037-52.
2. Lonjaret L, Lairez O, Galinier M, Minville V. Thrombolysis by recombinant tissue plasminogen activator during pregnancy: a case of massive pulmonary embolism. Am J Emerg Med 2011;29:694.e1-2.
3. Guyatt GH, Akl EA, Crowther M, Gutterman DD, Schuünemann HJ; American College of Chest Physicians Antithrombotic Therapy and Prevention of Thrombosis Panel. Executive summary: antithrombotic therapy and prevention of thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. Chest 2012;141(2 Suppl): 7S-47S.
4. Chechi T, Vecchio S, Spaziani G, Giuliani G, Giannotti F, Arcangeli C, et al. Rheolytic thrombectomy in patients with massive and submassive acute pulmonary embolism. Catheter Cardiovasc Interv 2009;73:506-13.
5. Kuo WT, Gould MK, Louie JD, Rosenberg JK, Sze DY, Hofmann LV. Catheter-directed therapy for the treatment of massive pulmonary embolism: systematic review and meta-analysis of modern techniques. J Vasc Interv Radiol 2009;20: 1431-40.
6. Handa K, Sasaki Y, Kiyonaga A, Fujino M, Hiroki T, Arakawa K. Acute pulmonary thromboembolism treated successfully by balloon angioplasty--a case report. Angiology 1988;39:775-8.
7. Vashchenko N, Korzets A, Neiman C, Bachar GN, Ori Y, Belenky A, et al. Retrospective comparison of mechanical percutaneous thrombectomy of hemodialysis arteriovenous grafts with the Arrow-Trerotola device and the lyse and wait technique. AJR Am J Roentgenol 2010;194:1626-9.
8. Kim WS, Pyun WB, Kang BC. The primary patency of percutaneous transluminal angioplasty in hemodialysis patients with vascular access failure. Korean Circ J 2011;41:512-7.
9. Rocek M, Peregrin JH, Lasovicková J, Krajícková D, Slavíoková M. Mechanical thrombolysis of thrombosed hemodialysis native fistulas with use of the Arrow-Trerotola percutaneous thrombolytic device: our preliminary experience. J Vasc Interv Radiol 2000;11:1153-8.
10. McLennan G, Trerotola SO, Davidson D, Rhodes CA, Lazzaro C, Dreesen J, et al. The effects of a mechanical thrombolytic device on normal canine vein valves. J Vasc Interv Radiol 2001;12:89-94.
11. Brown DB, Cardella JF, Wilson RP, Singh H, Waybill PN. Evaluation of a modified arrow-trerotola percutaneous thrombolytic device for treatment of acute pulmonary embolus in a canine model. J Vasc Interv Radiol 1999;10:733-40.
12. Rocek M, Peregrin J, Velimsky T. Mechanical thrombectomy of massive pulmonary embolism using an Arrow-Trerotola percutaneous thrombolytic device. Eur Radiol 1998;8:1683-5.
13. Trerotola SO, Johnson MS, Shah H, Namyslowski J, Filo RS. Incidence and management of arterial emboli from hemodialysis graft surgical thrombectomy. J Vasc Interv Radiol 1997; 8:557-62.
14. Kim M, Lee JY, Lee CW, Lee SW, Kang SJ, Yoon YH, et al. Deep vein thrombosis due to hematoma as a rare complication after femoral arterial catheterization. Yeungnam Univ J Med 2013;30:31-5.