



Case Reports

Successful management of acute massive pulmonary embolism using Angiovac suction catheter technique in a hemodynamically unstable patient[☆]



Ahmed K. Pasha^a, Mahir D. Elder^{b,c}, Daniyeh Khurram^d,
Branden A. Snyder^e, Mohammad Reza Movahed^{a,e,f,*}

^a Department of Internal Medicine, CareMore, Arizona, Tucson, AZ, USA

^b Heart and Vascular Institute, 4160 John R, Suite 510, Detroit, MI, USA

^c Wayne State University/Detroit Medical Center, Detroit, MI 48201, USA

^d Department of Internal Medicine, Providence Hospital, Southfield, MI, USA

^e Sarver Heart Center, University of Arizona, Tucson, AZ, USA

^f CareMore HealthCare, Tucson, AZ, USA

ARTICLE INFO

Article history:

Received 11 December 2013

Accepted 17 December 2013

Keywords:

Pulmonary embolism

Thrombolytic therapy

Thrombectomy

Thrombolysis

Thrombus suctioning

Catheter-based intervention

Embolectomy

ABSTRACT

Massive pulmonary embolism with hemodynamic instability is a life-threatening condition requiring immediate treatment. Urgent thrombectomy or thrombolysis is commonly used for the treatment of this condition. However, surgery is associated with high mortality rate and many patients have contraindications to thrombolytic therapy and are at high risk for bleeding. Catheter-based intervention has gained increasing popularity particularly in patients with contraindication to thrombolytic therapy or at high risk for surgical thrombectomy. Catheter-based thrombus removal can be achieved by many means such as suction, fragmentation, extraction or rheolytic thrombectomy. We present a case of an elderly lady who suffered from acute massive pulmonary embolism with hemodynamic compromise successfully treated with AngioVac catheter system (AngioDynamics, Albany, NY) with full recovery.

© 2014 Elsevier Inc. All rights reserved.

1. Introduction

Pulmonary embolism (PE) is associated with high mortality and morbidity and can be fatal in up to 10% of the patients [1,2]. PE is considered massive when occlusion of pulmonary artery is >50% of its cross-sectional area resulting in hemodynamic compromise [3,4]. If this obstruction exceeds 75%, the right ventricle has to acutely generate a systolic pressure greater than 50 mm Hg that can lead to right ventricular failure and death. Eighty-five percent of death in patients with massive PE occurs in the first 6 hours [4]. In the case of massive PE, embolectomy [5] or systemic thrombolysis [6] in addition to anticoagulation could rapidly reverse right ventricular failure and cardiogenic shock. However, major contraindications, such as prior surgery, trauma, stroke, or advanced cancer, make approximately one third of the patients with massive PE ineligible for thrombolysis [3,7]. Surgical embolectomy is an effective treatment of this condition but it requires a dedicated team and system in place [5] and is associated with significant morbidity [8]. With the advancement in interven-

tional procedures, catheter-based technology has gained increasing popularity that can combine clot destruction with local thrombolysis [9]. Catheter-based thrombus removal can be achieved by many means such as suction, fragmentation, extraction or rheolytic thrombectomy [10]. We present a case of an elderly lady who suffered from acute massive pulmonary embolism with hemodynamic compromise successfully treated with suction thrombectomy utilizing off-label use of AngioVac catheter system (AngioDynamics, Albany, NY) with full recovery.

2. Case

A 66-year-old female with a medical history significant for recurrent endometrial cancer and diabetes mellitus, presented with progressive dyspnea on exertion and generalized body weakness. Examination revealed tachycardia and hypoxia requiring 4 L of oxygen. Respiratory examination was clear to auscultation. Troponin was positive at 0.314 and BNP was 1245. Twelve-lead EKG showed sinus tachycardia and left-axis deviation, with poor R-wave progression. Two-dimensional echocardiogram revealed right ventricular free wall hypokinesis with spared apical contraction (Mc Connells sign) suggestive of acute pulmonary embolism. Subsequent chest CT revealed saddle pulmonary embolus extending

[☆] Conflict of interest: There is no conflict of interest.

* Corresponding author at: University of Arizona, 7091 E Speedway Blvd, Tucson, AZ 85710, USA. Tel.: +1 949 400 0091.

E-mail address: rmova@aol.com (M.R. Movahed).

into right and left pulmonary arteries as well as lobar arteries. Evidence of right heart strain was also present. The patient was given intravenous bolus of heparin and started on continuous heparin infusion. She developed hypotension and tachycardia consistent with cardiogenic shock. Pulmonary angiogram confirmed the diagnosis of saddle embolus in the main pulmonary artery extending into right upper and right lower pulmonary artery [Fig. 1 (a) and (b)]. She was deemed to be not a thrombolytic or surgical candidate. Due to the need for equipment to be setup, the thrombectomy was performed 3 hours later. An 8-French sheath was sutured into the right common femoral artery and a 4-French sheath was sutured in the left common femoral vein and the patient was transferred out of the interventional suite. The second procedure was performed under general anesthesia. Using an Amplatz Stiff wire and serial dilations, the right 8-French venous sheath was replaced by a 26-French Angiovac catheter (Fig. 2). The left 4-French venous sheath was replaced by a 17-French Angiovac circulator tubing. An 8-French long venous catheter was placed in the main pulmonary artery, and was exchanged over the j wire for Angiovac thrombectomy catheter distal to right pulmonary artery (Fig. 3). The embolus

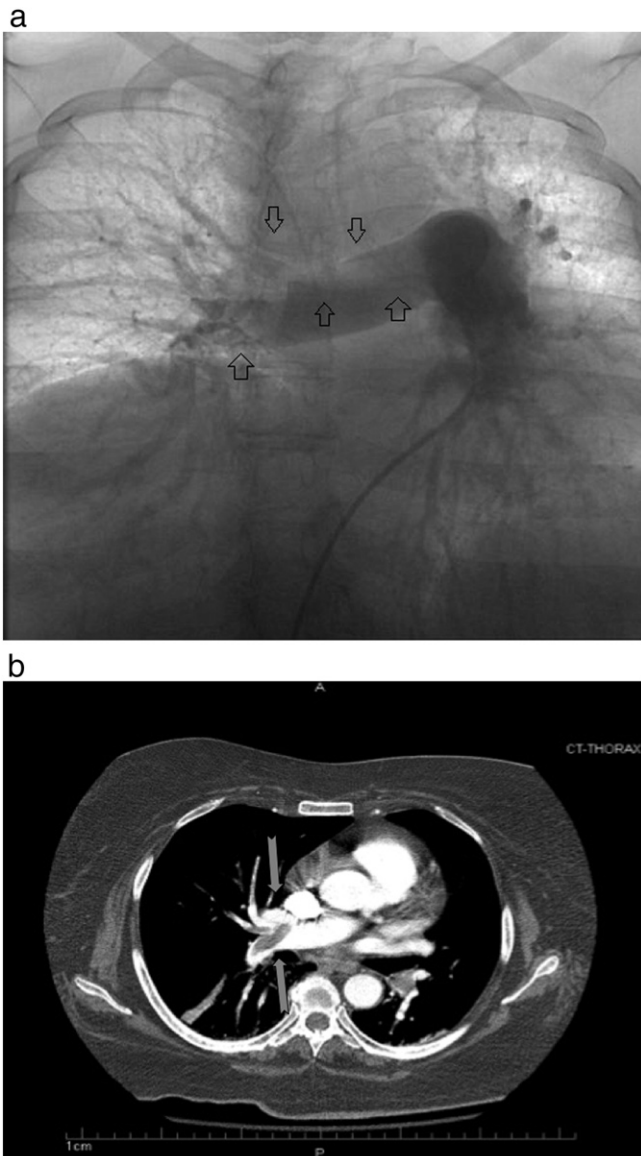


Fig. 1. (a) Pulmonary angiogram showing saddle embolus in right and left pulmonary arteries. (b) CT of chest showing the saddle embolus.

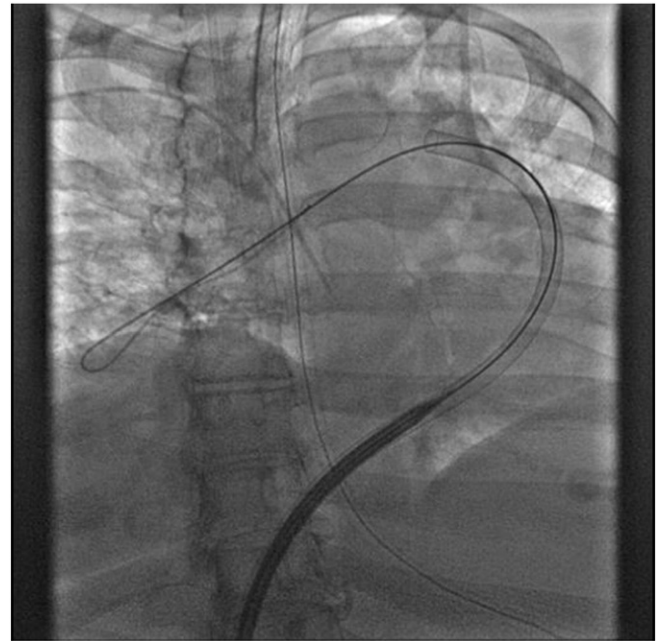


Fig. 2. Guide wire extending through the clot.

was partially removed by suction. Then central venous access was gained through internal jugular vein and a 6-French pigtail catheter was directed to the right ventricle. DSA mode right ventricular angiogram confirmed partial removal of large saddle embolus from pulmonary arteries (Fig. 4). Next, 10-mg of tPA was administered into the pulmonary artery through the pigtail connector. At the end of procedure the sheaths were withdrawn and hemostasis was achieved using manual compression. The patient remained in critical condition during the procedure requiring pressor support. She was observed in the ICU after the procedure where she made a rapid recovery and was discharged 7 days later. Follow-up echocardiogram showed resolution of right ventricular hypokinesia. On subsequent visits, she was fully ambulatory and stable without any symptoms on oral anticoagulation.

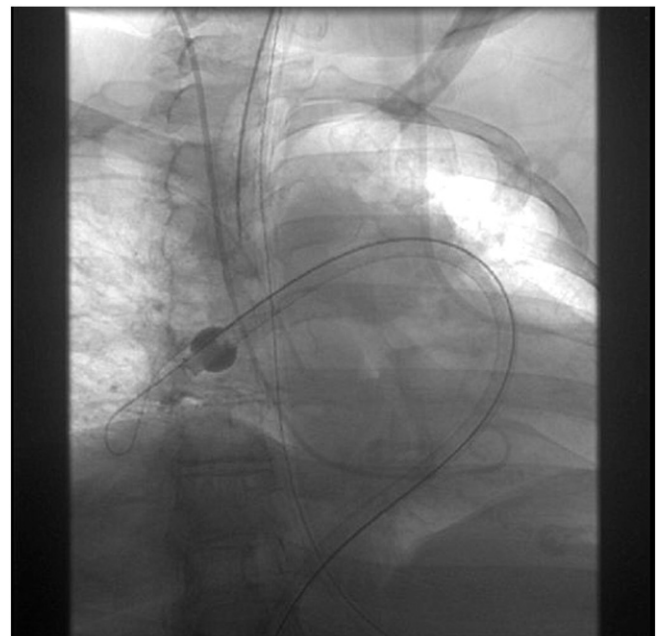


Fig. 3. Balloon and catheter traversed through the clot.



Fig. 4. Residual clot shown on repeat pulmonary angiogram following suction. Note the reduced size of clot.

3. Discussion

Angiovac system consists of Angiovac circuit, an extracorporeal bypass tubing system and Angiovac cannula, which is intended for venous drainage during extracorporeal bypass. The cannula has a balloon-actuated, expandable, funnel-shaped distal tip to facilitate flow, as well as to remove undesirable intravascular material during the performance of extracorporeal circulation as clots, thrombus tumor, myxoma and vegetations. Todoran et al. [11] reported the successful use of Angiovac cannula for the removal of intraatrial septic thrombus. To our knowledge there has been no case reported in the literature regarding suction embolectomy of a massive pulmonary embolism resulting in hemodynamic instability using Angiovac.

Massive pulmonary embolism leading to unstable vital signs warrants either systemic thrombolysis with anticoagulation [12], surgical thrombectomy [3] or catheter-based thrombolysis [9]. Thrombolysis is effective in patients both stable and unstable patients as compared to anticoagulation alone [13]. However, thrombolysis is associated with bleeding that can occur in 14% of patients [14] with a risk of cerebral hemorrhage up to 3% [15]. Surgical embolectomy is effective in patients with absolute contraindication to systemic thrombolysis [5] but is associated with high morbidity and mortality [16]. In one of the studies the case fatality for surgical embolectomy has been reported to be 39%–40% in unstable patients and between 23% and 27% in stable patients [8]. Our patient was a poor candidate for thrombolysis and surgery due to extensive metastatic cancer [7] and comorbidities. She had a large saddle embolus extending into her right and left pulmonary arteries with hemodynamic instability with very high risk for death without thrombus removal [4,6,17]. Surgery was also deemed to be risky considering her fragile state. She had a great respond to suction embolectomy with full recovery. Our case showed that off-label use of Angiovac suction catheter device provides a novel technique to remove large emboli effectively as an alternative method to other catheter-based devices. Further investigations in clinical trials are needed in order to prove usefulness of this device in treating patients with life-threatening pulmonary embolism. Our case is the first reported case describing details about the use of this device. Searching the literature, we found only one

abstract published about the use of this device in six patients with massive pulmonary embolism without reporting any detail about the outcome. AngioJet rheolytic thrombectomy is one of the most commonly used catheters for thrombolysis in patients with massive pulmonary embolism with some success up to 92% [18–21]. Recently, an ultrasound-assisted catheter-directed thrombolysis (USAT) has been shown to be superior to anticoagulation alone in patient with PE [22]. Mechanical breakdown and thrombolysis in subacute massive pulmonary embolism using a simple multipurpose catheter to break down thrombus have also been successful in these patients [23]. The choice of using specific catheter for thrombus removal in patients with massive PE should depend on the availability of the device and expertise of the operator.

References

- [1] Park B, Messina L, Dargon P, Huang W, Ciocca R, Anderson FA. Recent trends in clinical outcomes and resource utilization for pulmonary embolism in the United States: findings from the nationwide inpatient sample. *Chest* 2009 Jun 12;136(4):983–90.
- [2] Kucher N, Rossi E, De Rosa M, Goldhaber SZ. Massive pulmonary embolism. *Circulation* 2006 Jan 31;113(4):577–82.
- [3] Robison RJ, Fehrenbacher J, Brown JW, Madura JA, King H. Emergent pulmonary embolectomy: the treatment for massive pulmonary embolus. *Ann Thorac Surg* 1986 Jul;42(1):52–5.
- [4] Tapson VF, Witty LA. Massive pulmonary embolism. Diagnostic and therapeutic strategies. *Clin Chest Med* 1995 Jun;16(2):329–40.
- [5] Leacche M, Unic D, Goldhaber SZ, Rawn JD, Aranki SF, Couper GS, et al. Modern surgical treatment of massive pulmonary embolism: results in 47 consecutive patients after rapid diagnosis and aggressive surgical approach. *J Thorac Cardiovasc Surg* 2005 May;129(5):1018–23.
- [6] Guidelines on diagnosis and management of acute pulmonary embolism. Task Force on Pulmonary Embolism, European Society of Cardiology. *Eur Heart J* 2000 Aug;21(16):1301–36.
- [7] Kasper W, Konstantinides S, Geibel A, Olschewski M, Heinrich F, Grosser KD, et al. Management strategies and determinants of outcome in acute major pulmonary embolism: results of a multicenter registry. *Journal of the American College of Cardiology* 1997 Nov 1;30(5):1165–71.
- [8] Stein PD, Matta F. Case fatality rate with pulmonary embolectomy for acute pulmonary embolism. *The American Journal of Medicine* 2012 May;125(5):471–7.
- [9] Tajima H, Murata S, Kumazaki T, Nakazawa K, Ichikawa K, Yamamoto T, et al. Recent advances in interventional radiology for acute massive pulmonary thromboembolism. *J Nihon Med Sch* 2005 Apr;72(2):74–84.
- [10] Goldhaber SZ. Integration of catheter thrombectomy into our armamentarium to treat acute pulmonary embolism. *Chest* 1998 Nov;114(5):1237–8.
- [11] Todoran TM, Sobieszczek PS, Levy MS, Perry TE, Shook DC, Kinlay S, et al. Percutaneous extraction of right atrial mass using the Angiovac aspiration system. *Journal of Vascular and Interventional Radiology* 2011 Sep;22(9):1345–7.
- [12] Piazza G, Goldhaber SZ. Fibrinolysis for acute pulmonary embolism. *Vasc Med* 2010 Oct;15(5):419–28.
- [13] Dalla-Volta S, Palla A, Santolucandro A, Giuntini C, Pengo V, Visioli O, et al. PAIMS 2: Alteplase combined with heparin versus heparin in the treatment of acute pulmonary embolism. Plasminogen Activator Italian Multicenter Study 2. *J Am Coll Cardiol* 1992 Sep;20(3):520–6.
- [14] Mikkola KM, Patel SR, Parker JA, Grodstein F, Goldhaber SZ. Increasing age is a major risk factor for hemorrhagic complications after pulmonary embolism thrombolysis. *Am Heart J* 1997 Jul;134(1):69–72.
- [15] Goldhaber SZ, Visani L, De Rosa M. Acute pulmonary embolism: clinical outcomes in the International Cooperative Pulmonary Embolism Registry (ICOPER). *Lancet* 1999 Apr 24;353(9162):1386–9.
- [16] Bauer EP, Laske A, von Segesser LK, Carrel T, Turina MI. Early and late results after surgery for massive pulmonary embolism. *Thorac Cardiovasc Surg* 1991 Dec;39(6):353–6.
- [17] Casazza F, Becattini C, Bongarzone A, Cuccia C, Roncon L, Favretto G, et al. Clinical features and short term outcomes of patients with acute pulmonary embolism. The Italian Pulmonary Embolism Registry (IPER). [Internet] *Thromb Res* 2012;130(6):847–52.
- [18] Sakhuja R, Gandhi S, Rogers RK, Margey RJ, Jaff MR, Schainfeld R. A novel endovenous approach for treatment of massive central venous or pulmonary arterial thrombus, mass, or vegetation: the Angiovac suction cannula and circuit. *05 J Am Coll Cardiol* 2011;57(14 s1) [E1535–E1535].
- [19] Bonvini RF, Roffi M, Bounameaux H, Noble S, Müller H, Keller PF, et al. AngioJet rheolytic thrombectomy in patients presenting with high-risk pulmonary embolism and cardiogenic shock: a feasibility pilot study. *22 EuroIntervention* 2013;8(12):1419–27.
- [20] Wong CP, Ho HH, Jafary FH, Ong PJ. Rheolytic thrombectomy in patients with massive pulmonary embolism: a report of two cases and review of literature. *Acute Card Care* 2012;14(3):91–3.

- [21] 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(4):506–13.
- [22] Kucher N, Boekstegers P, Müller O, Kupatt C, Beyer-Westendorf J, Heitzer T, et al. Randomized controlled trial of ultrasound-assisted catheter-directed thrombolysis for acute intermediate-risk pulmonary embolism. *Circulation* 2013 In press.
- [23] Mohan B, Chhabra ST, Aslam N, Wander GS, Sood NK, Verma S, et al. Mechanical breakdown and thrombolysis in subacute massive pulmonary embolism: a prospective trial. *World, J Cardiol* 2013;5(5):141–7 26.