Journal of Cardiology and Cardiovascular Sciences

Commentary Open Access

Commentary: "Single Center Experience with the AngioVac Aspiration System."

Yi Shuen Chang*, Jason Salsamendi

Department of Vascular and Interventional Radiology, University of Miami Miller School of Medicine/Jackson Memorial Hospital, 1611 NW 12th Ave. WW-279, Miami, FL, 33136, USA

Article Info

Article Notes
Received: September 08, 2018
Accepted: October 09, 2018

***Correspondence:**
Yi Shuen Chang, Department of Vascular and Interventional Radiology, University of Miami Miller School of Medicine/ Jackson Memorial Hospital, 1611 NW 12th Ave. WW-279, Miami, FL, 33136, USA;
E-mail: yxc897@med.miami.edu.

Venous thromboembolism (VTE), which includes Deep Venous Thrombosis (DVT) and Pulmonary Embolism (PE) is the third most frequent cardiovascular disease[1,2]. VTE is a condition which affects all patients regardless of age, gender and ethnicity. It is estimated to have an annual incidence which ranges from 104-183 per 100,000 person-years, similar to that of stroke. The variation of incidence rates may depend on multiple factors including age distribution and ethnicity, and the risk factors exposed by the patient population[3-15]. The important risk factors for VTE include increasing age, high body mass index, male gender, malignancy, immobilization, oral contraceptive pills, pregnancy, and coagulopathies. Due to its high recurrence rate and the patient population at risks who often presents with multiple comorbid conditions, VTE results in a healthcare financial burden of $10 billion annually in the United States[2]. It is undoubtedly a major public health concern with the burden of disease affecting both developed and developing nations. Untreated VTE often presents with chronic and potentially life-threatening complications such as post-thrombotic syndrome (PTS) and chronic thromboembolism pulmonary hypertension (CTEPH). CTEPH is reported as a complication in 3.8% of patients who experienced acute pulmonary embolism and is associated with significant morbidity and mortality[16]. PTS occurs in 20%-50% of the patients, presenting with clinical manifestations of chronic leg pain, edema and ischemic ulcers; negatively impacting the quality of life for the patients[17]. American Heart Association recommends warfarin remains as the first line treatment for acute proximal DVT to prevent recurrence and PE; American College of Chest Physicians guideline suggests non-vitamin K antagonist being the first line[18,19]. Additionally, Larsen et al reported patient-self-management of oral anticoagulation promotes treatment adherence leading to decreased recurrence of DVT among those patients[20]. However, 20-50% of patients continue to develop PTS with adequate oral anticoagulant[21]. Early *en-bloc* removal of the thrombus is preferred by using catheter-directed therapy. Recent studies suggest the potential benefits of early thrombus removal in restoring venous patency and valvular competency[22]. The conventional surgical management of VTE is of historical value now; with the advent of pharmacomechanical thrombolysis and catheter-directed thrombolysis which may be more efficient with fewer bleeding complications.

The challenge faced by interventionalist in the directed therapy of venous thrombosis is dissolving the thrombus without fragmenting and embolizing it, leading to PE-related mortality. Currently, there is no ubiquitous acknowledgment in regard to the superiority in any

of the catheter-directed therapy (CDT) in terms of safety and efficiency. However, more practitioners are leaning towards CDT given its efficiency. It is crucial to employ treatment methods after considering risk-benefit ratio, which varies among each patient. Given the previously described discernment, there is therefore a need to investigate the directed thrombolytic modalities available in managing VTE.

In this study, Salsamendi et al discussed the experiences with the AngioVac Aspiration System (AngioDynamics, Latham, New York) in the removal of thrombus in a single institution[23]. AngioVac device is a FDA approved device, designed to remove fresh, soft thrombi or emboli during extracorporeal bypass for up to 6 hours. AngioVac was reportedly used for multiple clinical implications such as bland or tumor thrombus evacuation in the right atrium and vena cava, prohibition of pulmonary emboli, debridement of implantable device vegetation and the management of symptomatic iliocaval thrombus[24-28]. As with other extracorporeal circulation, anticoagulation is mandated throughout the procedure, monitored by the activated clotting time (ACT). This study was conducted retrospectively on the cases which occurred over a year involving 7 patients with a mean age of 49.6 years. The author highlighted the importance of performing a CDT including mechanical thrombectomy on the patients with a VTE, in order to reduce the risk of having potentially fatal complications such as pulmonary embolism. They also shed light on the benefits of providing early intervention for DVT in preventing its progression into a disturbing chronic complication of PTS[23].

In their study, AngioVac was demonstrated to be useful in the evacuation of the thrombus in various vascular beds. The interventions performed in 5 out of 7 patients who had the thrombus in inferior vena cava (IVC), iliac veins and superior vena cava (SVC) were successful with the removal of the clot in entirety. In one of the cases which involved the right atrium, the thrombus was not eradicated completely; however, it showed diminution in size and the patient was subsequently maintained on anticoagulation therapy without complication. It is worth mentioning the successful utilization of AngioVac in achieving a near complete evacuation of multiple thromboses found in Fontan conduit, Glenn shunt and right main pulmonary artery in a young patient who underwent a complex cardio-vascular surgical procedure further complicated by anoxic brain injury, sepsis, bacteremia and empyema. This is a crucial and promising finding of the device as the study has reported the presence of intracardiac thrombus in a hemodynamically unstable adult patient has a 77.7% mortality rate with short-term recurrence[29]. However, there was a lack of follow up data on this young patient's prognosis due to logistic limitation.

Based on their experiences with the device, the authors observed and reported the employment of AngioVac in a submassive pulmonary artery embolism was limited by the technical difficulty in maneuvering the device through the pulmonary artery branches due to the restricted steerability of the cannula[23]. A similar technical challenge was also reported by Donaldsan et al, who mentioned the stiffness of the guidewire in hindering the user's movement navigating through the right atrium[30]. Another factor contributing to this technical difficulty includes the narrowed pulmonary vessels caliber in relative to those of iliac, and the distance between the femoral access point and the pulmonary artery. The authors acknowledged the limitation of the study is the small sample size of both the study itself and within each vascular bed with only 7 patients participated in total, reducing the power of the study[23]. Other limitations are associated with the nature of retrospective studies such as selection bias, unmeasured confounders and unsuccessful long term follow ups. The benefits of AngioVac in the management of VTE are indisputable with its technological innovation in allowing it to remove thrombus involving large veins in a single setting. The authors further commented on the equipment used for AngioVac System costs 1000% more compared to its pharmacomechanical counterparts. Salsamendi et al argued the high cost of AngioVac System could be partially compensated by not requiring an angiography suite follow up, less ICU inpatient stays with better outcomes. There is insufficient data comparing the advantages of AngioVac System to its counterparts in terms of providing treatment resulting in symptom alleviation and better patient satisfaction in uncomplicated thrombus evacuation. However, Donaldson et al suggested patients with less complicated thrombus should choose catheter-directed therapy or pharmaco-mechanical therapy as their first line[30].

Patient satisfaction and treatment outcomes should remain the utmost priorities when choosing a treatment modality. The study performed by Salsamendi et al provides justifiable evaluation with evidence that AngioVac remains a safe, alternative and feasible method in eliminating large volume of clot without compromising the hemodynamic stability with its extracorporeal circulation bypass feature. A recent literature review by Basman et al reports >80% successful evacuation of iliocaval and intracardiac thrombi and 44% of pulmonary artery thrombus[31]. Nevertheless, it should only be reserved in the selected group of cases and be used by experienced interventionist given its high cost and technical demands required for the procedure. Potential candidates who are likely to benefit from AngioVac include but not limited to patients who are poor surgical candidates with, in hypercoagulable state such as malignancy and ongoing bacteremia. They are more prone to present with huge thrombus burden with the the risk of

hemorrhagic conversion and hemodynamic instability. The avoidance of thrombolytic and rheolytic thrombectomy in these patients can prevent unnecessary bleeding and hemolysis. Expanding the use of the device in these selected patient population is justifiable in optimizing the treatment outcome while minimizing ICU stays as discussed by the authors. Location of the thrombus also remains as a crucial factor with increased success rate of thrombus removal in iliocaval region. The learning curve is steep as puncturing through the right atrium or pulmonary artery can result in detrimental consequences; both to the health outcome of the patient and the cost of treatment. There was one reported case of AngioVac associated mortality by Al Hakim et al due to right ventricular free wall perforation[32]. It is a well-recognized fact that the cost of healthcare in intervention is constantly rising, partially attributed to the explosion of modern medical technologies. Interventionists are given the trust in making legitimate decisions when facing the crossroads of optimizing patient care and treatment outcome while being cognizant in causing potential economic burden in that process. Encouragement should be given for performing such studies as it provides more data for the physicians to identify and choose the treatment device after synthesizing the information.

References

1. Glynn RJ, Rosner B. Comparison of risk factors for the competing risks of coronary heart disease, stroke, and venous thromboembolism. Am J Epidemiol. 2005; 162(10): 975–82. doi: 10.1093/aje/kwi309.
2. Beckman M, Hooper WC, Critchley S, et al. Venous thromboembolism: a public health concern. Am J Prev Med. 2010; 38(4 Suppl): 495-501.
3. Anderson FA Jr, Wheeler HB, Goldberg RJ, et al. A population-based perspective of the hospital incidence and case-fatality rates of deep vein thrombosis and pulmonary embolism. The Worcester DVT Study. Arch Intern Med. 1991; 151: 933–938.
4. Hansson PO, Welin L, Tibblin G, et al. Deep vein thrombosis and pulmonary embolism in the general population. 'The Study of Men Born in 1913'. Arch Intern Med. 1997; 157: 1665–1670.
5. Silverstein MD, Heit JA, Mohr DN, et al. Trends in the incidence of deep vein thrombosis and pulmonary embolism: a 25-year population-based study. Arch Intern Med. 1998; 158: 585–593.
6. Oger E. Incidence of venous thromboembolism: a community-based study in Western France. EPI-GETBP Study Group. Groupe d'Etude de la Thrombose de Bretagne Occidentale. Thromb Haemost. 2000; 83: 657–660.
7. Cushman M, Tsai AW, White RH, et al. Deep vein thrombosis and pulmonary embolism in two cohorts: the longitudinal investigation of thromboembolism etiology. Am J Med. 2004; 117: 19–25.
8. Heit JA. Venous thromboembolism: disease burden, outcomes and risk factors. J Thromb Haemost. 2005; 3: 1611–1617.
9. Spencer FA, Emery C, Lessard D, et al. The Worcester Venous Thromboembolism study: a population-based study of the clinical epidemiology of venous thromboembolism. J Gen Intern Med. 2009; 21: 722–727.
10. Naess IA, Christiansen SC, Romundstad P, et al. Incidence and mortality of venous thrombosis: a population-based study. J Thromb Haemost. 2007; 5: 692–699.
11. Spencer FA, Emery C, Joffe SW, et al. Incidence rates, clinical profile, and outcomes of patients with venous thromboembolism. The Worcester VTE study. J Thromb Thrombolysis. 2009; 28: 401–409.
12. Tagalakis V, Patenaude V, Kahn SR, et al. Incidence of and mortality from venous thromboembolism in a real-world population: the Q-VTE Study Cohort. Am J Med. 2013; 126(832): e813–e821.
13. Huang W, Goldberg RJ, Anderson FA, et al. Secular trends in occurrence of acute venous thromboembolism: the Worcester VTE study (1985-2009). Am J Med. 2014; 127(829–839): e825.
14. Rothwell PM, Coull AJ, Giles MF, et al. Change in stroke incidence, mortality, case-fatality, severity, and risk factors in Oxfordshire, UK from 1981 to 2004 (Oxford Vascular Study). Lancet. 2004; 363: 1925–1933.
15. Koton S, Schneider AL, Rosamond WD, et al. Stroke incidence and mortality trends in US communities, 1987 to 2011. JAMA. 2014; 312: 259–268.
16. Pengo V, Lensing AW, Prins MH, et al. Thromboembolic Pulmonary Hypertension Study Group. N Engl J Med. 2004 May 27; 350(22): 2257-64.
17. Kahn SR. How I treat postthrombotic syndrome. Blood. 2009; 114(21): 4624–4631. doi: 10.1182/blood-2009-07-199174.
18. Jaff MR, McMurtry MS, Archer SL, et al. Management of massive and submassive pulmonary embolism, iliofemoral deep vein thrombosis, and chronic thromboembolic pulmonary hypertension: A scientific statement from the american heart association. Circulation. 2011; 123(16): 1788-1830. DOI: 10.1161/CIR.0b013e318214914f
19. Kearon C, Akl EA, Ornelas J, et al. Antithrombotic Therapy for VTE Disease: CHEST Guideline and Expert Panel Report. Chest. 2016 Feb; 149(2): 315-352.
20. Larsen TB, Skjoth F, Grove EL, et al. Effectiveness of self-managed oral anticoagulant therapy in patients with recurrent venous thromboembolism. A propensity-matched cohort study. Thromb Haemost. 2016; 116(3): 524–529.
21. Bromley A, Plitt A. A Review of the Role of Non-Vitamin K Oral Anticoagulants in the Acute and Long-Term Treatment of Venous Thromboembolism. Cardiol Ther. 2018; 7: 1-13. 10.1007/s40119-018-0107-0
22. Casey ET, Murad MH, Zumaeta-Garcia M, et al.Treatment of acute iliofemoral deep vein thrombosis. J Vasc Surg. 2012; 55: 1463-1473.
23. Salsamendi J, Doshi M, Bhatia S, et al. Single Center Experience with the AngioVac Aspiration System.Cardiovasc Intervent Radiol. 2015; 38: 998-1004. 10.1007/s00270-015-1152-x
24. Wunderlich N, Franke J, Sievert H. A novel technique to remove a right atrial thrombotic mass attached to a Patent Foramen Ovale (PFO) closure device. Catheter Cardiovasc Interv. 2013.
25. Divekar AA, Scholz T, Fernandez J. Novel percutaneous transcatheter intervention for refractory active endocarditis as a bridge to surgery: AngioVac aspiration system. Catheter Cardiovasc Interv. 2013; 81(6): 1008–1012.
26. Todoran TM, Sobieszczyk PS, Levy MS, et al. Percutaneous extraction of right atrial mass using the AngioVac aspiration system. J Vasc Interv Radiol. 2011; 22(9): 1345–1347.
27. Pasha AK, Elder MD, Khurram D, et al. Successful management of acute massive pulmonary embolism using AngioVac suction catheter technique in a hemodynamically unstable patient. Cardiovasc Revasc Med. 2013; 15(4): 240–243.
28. Smith SJ, Behrens G, Sewall LE, et al. Vacuum-assisted thrombectomy device (AngioVac) in the management of symptomatic iliocaval thrombosis. J Vasc Interv Radiol. 2014; 25(3): 425–430.

29. Arboix A, Alio J. Cardioembolic stroke: clinical features, specific cardiac disorders and prognosis. Curr Cardiol Rev. 2010; 6: 150–161.

30. Donaldson CW, Baker JN, Narayan RL, et al. Thrombectomy using suction filtration and veno-venous bypass: Single center experience with a novel device. Catheter Cardiovasc Interv. 2014. doi: 10.1002/ccd.25583.

31. Basman C, Rashid U, Parmar YJ, et al. The role of percutaneous vacuum-assisted thrombectomy for intracardiac and intravascularpathology. J Card Surg. 2018; 33: 666–672.

32. Al-Hakim R, Park J, Bansal A, et al. MoriartyEarly experience with AngioVac aspiration in the pulmonary arteries. J Vasc Interv Radiol. 2016; 27 (5): 730-734.