Next Generation of CAVT™: Lightning Flash™ 3.0 in Practice

With Clay Wiske, MD, and Adam Reichard, MD

Pulmonary embolism (PE) is moving to the forefront of the venous thromboembolism (VTE) conversation, emerging as a time-critical disease state that demands both clinical urgency and technical reliability. As treatment volumes rise and procedural strategies continue to evolve, so has the expectation for thrombectomy tools. Today's systems must deliver speed without sacrificing safety, and precision without adding complexity. With these priorities in mind, Penumbra's latest launch of Lightning Flash™ 3.0 introduces the most advanced evolution of the Lightning Flash technology to date, designed for the rapid removal of pulmonary and venous thrombus.

From a speed perspective, Lightning Flash 3.0 shows a clear step forward with 1.3 times faster clot removal,* enabled by a nearly 40% increase in diameter for the aspiration tubing. The larger lumen tubing is engineered to reduce systematic friction caused by previously ingested thrombus, helping ensure full vacuum power is maintained at the catheter tip. An automated decompression feature further mitigates friction buildup within the tubing, minimizing thrombus-related obstructions during aspiration. Together, these design choices translate into efficient aspiration and allow for shorter procedure times.

This upgraded technology is designed to mitigate blood loss frontline, streamlining procedure workflow by eliminating the need for blood-return strategies. This improvement is attributed to enhanced algorithmic sensitivity and a notable architectural change: relocating the clot-detection computer from the top of the canister to just 18 inches behind the CAT16 catheter. By positioning the sensor closer to the point of thrombectomy, the system is better able to distinguish between thrombus and patent flow, helping preserve blood volume without compromising efficacy. From a safety standpoint, Lightning Flash 3.0 has demonstrated 60% fluid savings.*

Workflow simplicity rounds out the system with the updated user interface with the addition of a Flash console, providing clear, streamlined audiovisual feedback with an intuitive layout. Integrated air detection and straightforward operation reduce technologic complexity and enable clinicians to focus where it matters most—on the patient and the procedure.

Built with thrombectomy cases in mind, the Element™ sheath (Penumbra, Inc.) is the first laser-cut hypotube sheath on the market and is designed to be used with Penumbra's 16-F platform. Available in lengths of 13, 33, 45, and 65 cm, the 17-F Element features a unique HemoLock™ Dual Valve system—combining a 360° rotating hemostatic valve with a removable cross-cut designed to help maintain hemostasis during access and clot removal.

Element and Lightning Flash 3.0 put Penumbra at the forefront of device innovation and underscore their commitment to thrombectomy solutions that prioritize speed, safety, and simplicity in the treatment of PE.

*Compared to Lightning Flash 2.0. Tests performed and data on file at Penumbra, Inc. Test performed using bovine blood and water. Bovine blood took 1.3x more time to be fully ingested in bench top testing of Lightning Flash 2.0 when compared to Lightning Flash 3.0, while 60% less water was removed with Lightning Flash 3.0 when compared to Lightning Flash 2.0. Bench test results may not be indicative of clinical performance.

CASE 1: NEXT-GENERATION LIGHTNING FLASH 3.0 CLEARS RIGHT-SIDED PE

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Disclosures: None.

PATIENT PRESENTATION

A woman in her early 70s with a relevant history of uterine carcinoma on immunotherapy with left iliac vein compression presented to the emergency department with shortness of breath and severe pain, swelling, discoloration, and numbness of the left leg. She was progressively hypoxic and hypotensive and was intubated and started on multiple pressors.

A CT scan demonstrated thrombus in the right pulmonary artery (PA) and extensive thrombus of the left

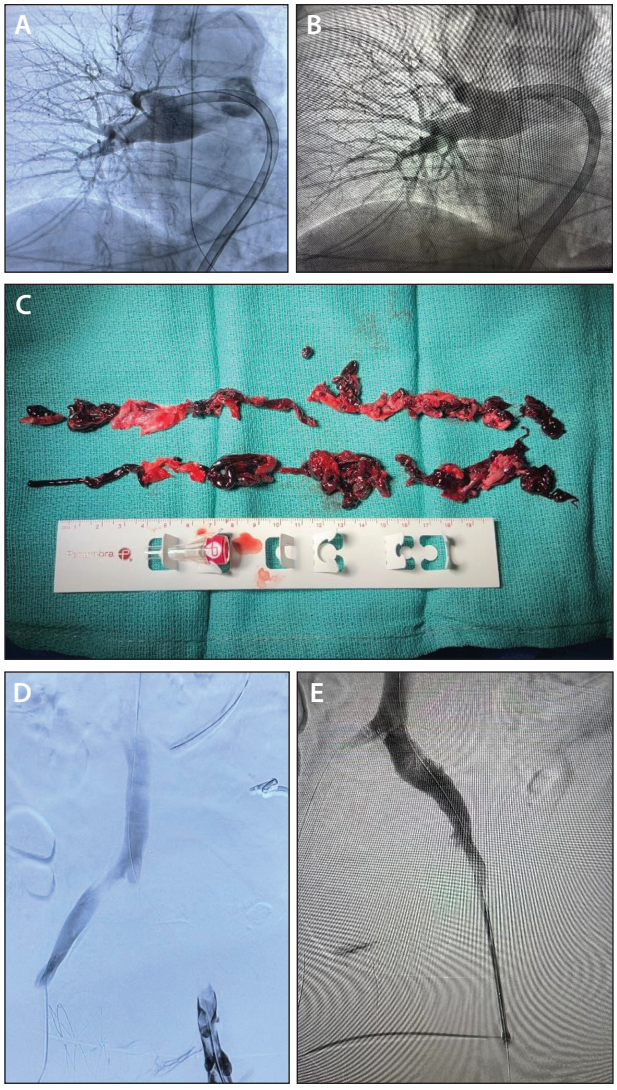

Figure 1. Angiogram showing right-sided pulmonary thrombus (A). Follow-up angiogram showing target pulmonary thrombus removed after thrombectomy (B). Left lower extremity venous thrombus extracted (C). Pre-thrombectomy angiogram (D). Post-thrombectomy angiogram (E).

lower extremity extending from the compressed left iliac vein inferiorly throughout the left lower extremity venous system. Her physical examination was consistent with phlegmasia with high-resistance signals in the left foot compared to palpable pulses in the right foot.

The patient's family felt that it would be consistent with the patient's wishes to proceed with intervention. We discussed interventions for both the PE and the acutely threatened left lower extremity.

Given the concern for massive PE, as well as an acutely threatened limb, an approach was taken that would provide the best probability of survival and thus the best probability of rapidly addressing the right PA thrombus. As a secondary goal, because the left leg was acutely threatened, an approach that would potentially facilitate left leg thrombectomy in a rapid fashion was favored.

INTERVENTION

Bilateral common femoral vein access was obtained. The right-sided access was primarily used to facilitate thrombectomy, and the left-sided access was obtained to provide a rail for up-and-over sheath and catheter advancement in anticipation of potential lower extremity thrombectomy. A 17-F, 65-cm Element sheath was advanced into the right PA, and a right-sided thrombus affecting multiple segmental branches was identified (Figure 1A). The 16-F Lightning Flash 3.0 catheter was advanced over a Rosen wire into the right PA, and aspiration was turned on; near-immediate evacuation of the target thrombus was achieved and confirmed by follow-up angiography (Figure 1B). Following successful pulmonary thrombectomy, a decrease in PA pressure was noted.

The focus was shifted to the left leg. A 0.035-inch guidewire was snared for through-and-through up-and-over access. The same Lightning Flash 3.0 was reintroduced and advanced across the iliocaval confluence. Thrombectomy of the left iliac system was successful. The through-and-through wire was removed such that left vein thrombectomy could be performed as well. After three passes, a significant amount of thrombus was removed (Figure 1C). Final angiography demonstrated restored patency after placement of an Abre stent (Medtronic) (Figure 1D and 1E).

DISCUSSION

The upgraded Lightning Flash 3.0 clot detection algorithm was notable for enhancing sensitivity to blood and thrombus and enabled a single-session thrombectomy for pulmonary and venous thrombus with mitigated estimated blood loss and avoidance of tissue plasminogen activator. Additionally, the trackability of Penumbra's comprehensive VTE platform facilitated efficient navigation through complex and variable patient anatomy.

CASE 2: BILATERAL PULMONARY THROMBUS BURDEN SUCCESSFULLY REMOVED WITH LIGHTNING FLASH 3.0

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PATIENT PRESENTATION

A man in his late 60s presented to the hospital with a 1-week history of persistent shortness of breath. On presentation, the patient was tachycardic with a normal blood pressure. Labs were significant for elevated troponin levels. CT demonstrated right heart strain, with a RV/LV ratio of 1.4. Additionally, bilateral pulmonary thrombus was identified, including a large saddle component. Transthoracic echocardiography confirmed RV strain.

INTERVENTION

Initial access was obtained via the right common femoral vein using an 8-F sheath that was upsized to a 17-F Element sheath, and Lightning Flash 3.0 was advanced over a 0.035-inch wire into the right PA. With the Lightning Flash 3.0 aspiration catheter positioned, the 0.035-inch wire was removed and 10 mL of contrast was loaded into the catheter, followed by a 20-mL saline flush to deliver the contrast into the right PA vasculature. Angiography demonstrated an occlusion in the right upper lobar artery (Figure 1A).

The aspiration catheter was then torqued and positioned proximal to the occlusion, at which point aspiration was initiated. The Lightning Flash console (Figure 1B) illuminated yellow, and the valve cadence increased, indicating catheter engagement with thrombus. The Lightning Flash 3.0 catheter was retracted toward the right main PA. Upon retraction, a large thrombus burden was seen being evacuated through the system. Subsequently, the Lightning Flash system transitioned to sampling mode, indicating the target segment had been cleared. Repeat contrast injection via the Lightning Flash catheter confirmed resolution of thrombus (Figure 1C).

Attention was directed to the left main PA, which contained the majority of the thrombus burden. With the wire in place, the double-bend HTORQ tip configuration of the Lightning Flash 3.0 catheter facilitated seamless access into the left main PA for pre-thrombectomy imaging, revealing extensive thrombus (Figure 1D). Aspiration was initiated, and the target thrombus was successfully removed in three passes (Figure 1E).

DISCUSSION

In total, cumulative aspiration time was 6 minutes, and the interval from initial imaging to device removal and access site closure was 25 minutes. Estimated blood loss (EBL) for this bilateral PE intervention was 100 mL.

The enhanced aspiration power of Lightning Flash 3.0 was evident, as demonstrated by the rapid aspiration time and the successful removal of this large thrombus burden, allowing the patient to be taken off the table as soon as possible. The improved accuracy of the clot detection algorithm incorporated into the Lightning Flash 3.0 software was apparent and enabled minimization of EBL. ■

Disclaimer: The opinions and clinical experiences presented herein are for informational purposes only. The results may not be predictive of all patients. Individual results may vary depending on a variety of patient-specific attributes.

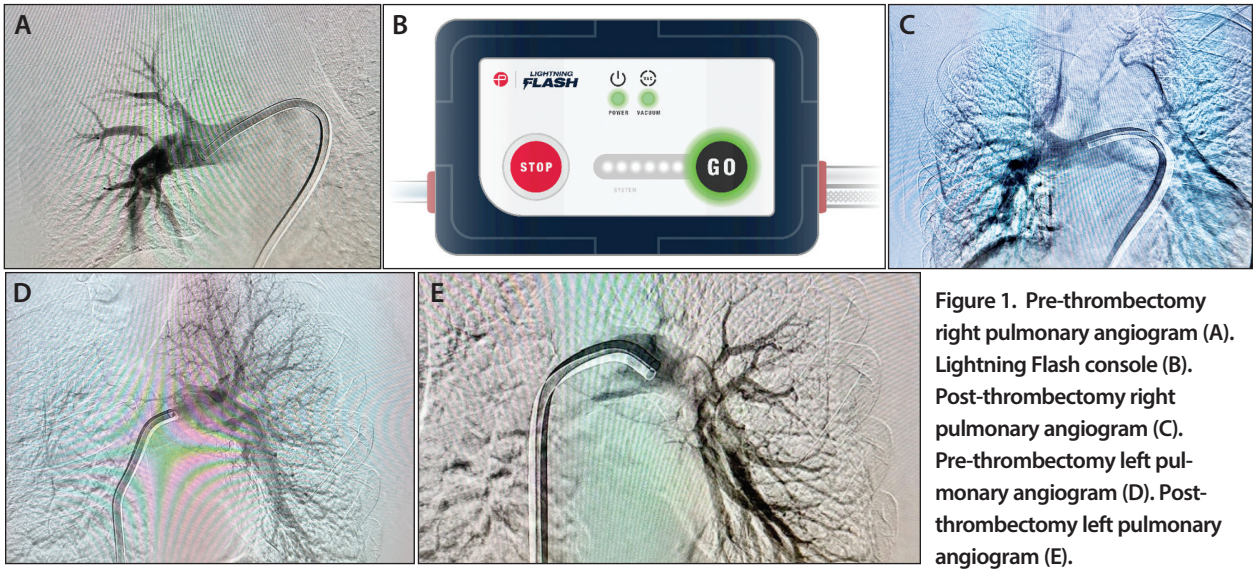

Figure 1. Pre-thrombectomy right pulmonary angiogram (A). Lightning Flash console (B). Post-thrombectomy right pulmonary angiogram (C). Pre-thrombectomy left pulmonary angiogram (D). Post-thrombectomy left pulmonary angiogram (E).