# Interventional Therapy for Acute Pulmonary Embolism

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When a patient(pt) with acute pulmonary embolism (PE) is presented to the emergency department, it is important to first stratify the potential risks by calculating the **PE severity index score(PESI)**. The PESI score is calculated by adding the point values respective of each factor. The simplified PESI score gives one point for the presence of age (>80 years), cancer, chronic heart failure, chronic pulmonary disease, pulse rate (<+110 bpm), systolic BP <100 mmHg, artery oxygen saturation<90%. If the simplified PESI score is >=1, it suggests a 30 day mortality risk of 10.9%. It is also important to predict early mortality risk by classifying a PE pt into high, intermediate or low **risk category depending on the presence of four risk indicators**.

High risk PE pts have hemodynamic instability, high PESI score, RV dilation, and troponin elevation. Intermediate high PE pts have no hemodynamic instability but still have a high PESI score, RV dilation and troponin elevation whereas, intermediate low PE pts have no hemodynamic instability but have either RV dilation or troponin elevation. The most recently published ESC guideline suggests that, **for high risk PE, a catheter directed treatment(CDT) should be considered where thrombolysis is contraindicated or has failed as Class IIa indication. It also suggests that CDT should be considered for pts with hemodynamic deterioration on anticoagulation treatment in intermediate or low risk PE pts as Class IIa indication**. The treatment options for CDT varies from local clot aspiration or disruption with a pigtail catheter to local catheter directed thrombolysis using a multihole catheter. Angiojet is not approved for PE due to increased procedural related morbidity or mortality. There are also mechanical thrombectomy with Inari Flowtriver or Penumbra indio aspiration system. **Inari Flowtriever system** is designed to aspirate clots by introducing highly trackable large catheters connected with a big syringe. It also includes various sizes of self expanding nitinol discs that disrupt and deliver the clots to the Flowtriever catheter. When the Flowtriever catheter brought near the clot area, the flush port stop cock is closed and the syringe is pulled back and locked. Opening the stop cock releases the vacuum and aspirates the clot. It also includes a blood filtration system that can immediately transfuse the filtered blood to the patient via side port of the sheath to reduce the blood loss. Outcomes from the FLASH registry from 800 enrolled pts shows on-table hemodynamic improvement with 7.6 mmHg in mean PA pressure drop and 18.9 % of cardiac index increase. There were no device-related serious adverse events. The result of FLAME trial showed a low mortality rate of 1.9%, which represented a 90% reduction compared to the 29.5% mortality rate seen in patients treated with other therapies. The next commonly used mechanical thrombectomy device is **Penumbra indigo system**. It is powered by an engine and provides sustained aspiration. The sensor differentiates thrombus and blood and allows for either continuous aspiration on the clot or intermittent aspiration on the blood. The Extract PE trial is a prospective single arm multicenter study that enrolled 119 symptomatic acute submassive PE with intermediate high risk. The trial showed 27.3% reduction of RV/LV ratio and 1.7% of major adverse events. The next device is **Ekosonic Endovascular System (EKOS)** which is the ultrasound assisted catheter based local thrombolytic infusion system with assistance of ultrasound. The main idea is that Ultrasound wave separates the fibrin strands, exposing more plasminogen receptor sites. Also the acoustic streaming drives the lytic agents deep into the clot. EKOS procedure is compared separately to heparin therapy in the Ultima PE trial. EKOS or ultrasound assisted CDT was superior to anticoagulation alone in the reversal of RV dilation. EKOS procedure was also studied in SEATTEL II with 150 pts. TPA is locally infused 1mg/hr for 24 hours with one device or 12 hours for 2 devices into each lung. The outcome showed 25% decrease in CT measured RV/LV diameter ratio over 48 hours and 30% decrease in PA systolic pressure by the end of the procedure. Interestingly, the SUNSET trial result reveals that ultrasound assisted local thrombolytics has similar PA thrombus reduction and RV/LV ratio compared to the standard catheter directed thrombolysis with a multihole catheter. AlphaVac is an updated version of AngioVac eliminating the need for perfusion pump by using ergonomic handle which designed to offer aspiration of thrombi or clot in transit in right heart.