Aspiration Thrombectomy of Intermediate-High Risk Pulmonary Embolism Causing Status Epilepticus due to Cerebral Hypoxia

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Introduction
Pulmonary embolism (PE) was recorded as the underlying cause of mortality in 11,000-12,000 deaths annually in the United States. The prognosis from PE depends on the degree of obstruction and consequent cardiovascular hemodynamic instability. In certain cases of high and intermediate risk PE, thrombolytics and/or angioplasty are contraindicated, or there is acute onset of right ventricular failure and cardiopulmonary compromise, which limits the therapeutic success of traditional therapies. Newer treatment modalities utilizing catheter-directed mechanical and aspiration thrombectomy such as the Inari FlowTriever System (Inari Medical, CA, USA) provide fast, effective, and minimally invasive method of clot removal without the use of thrombolysis.

Case Presentation
A 26 year old man with no significant past medical history presented as an outside hospital transfer to our tertiary care center for urgent treatment of submassive PE. The patient had recent history of right femur fracture requiring orthopedic surgery approximately two weeks prior. The patient was taken to an outside emergency department after suffering a witnessed grand mal seizure at home, and also had multiple seizures en-route to the hospital. On admission, he was post-stab, tachycardic, tachypneic, and severely dyspneic with oxygen saturations in the 80s. Patient was deemed to be in status epilepticus and emergency intubated for airway protection. CT head was unremarkable but too early to comment on possible ischemic stroke from paradoxical embolus. CTA chest demonstrated large saddle PE, with evidence of right heart strain. The etiology of the seizure was presumed to be cerebral hypoxia in the setting of acute PE. The calculated PESI score was 136 (Class V, Very High Risk: 10-24.5% 30-day mortality). Patient was emergently transferred to our tertiary care center, and PERT was activated.

Upon multidisciplinary discussion with the PERT, decision was made to perform aspiration thrombectomy in order to avoid thrombolytic therapy in the setting of questionable ischemic stroke and recent orthopedic surgery.

Intervention
Bilateral common femoral vein access was obtained. Through the right femoral access, a 5-french AP2 angled pigtail catheter was used to traverse the right heart and selectively catheterize the main pulmonary artery (PA). Upon the left femoral vein access, a 5-french FHC flush catheter was advanced into the right atrium (RA). Pre and post intervention RA and PA pressure measurements were obtained, as well as venous blood gas samples in order to calculate the cardiac index (CI).

A 26-French Gore dry seal sheath was placed in the right femoral vein, and mechanical aspiration thrombectomy of both the right and left pulmonary arteries was performed using the Inari FlowTriever System (Fig 2.5 below), which utilizes large lumen aspiration catheters (Triever catheters - 24 french, 20 french, and 16 french), manual syringe aspiration, and mechanical clot disruption with nitinol disks, to dislodge and aspirate large volumes of thrombus.

Aspiration thrombectomy was performed in both right and left lung, and mechanical disruption was possible with nitinol disks utilized with aspiration. Post aspiration, there was a significant improvement in hemodynamics with resolution of right heart strain.

Hospital Course
Patient returned to the ICU for close post-procedure monitoring and was weaned on postoperative day 1. Vital signs had normalized, and he was saturating well on room air. He was alert and oriented on exam and subjectively reported that his dyspnea was much improved. Patient suffered no further seizure episodes during his hospitalization stay. MRE/MRA/MRI head and neck were performed to rule out ischemic infarct from paradoxical embolus, and were all unremarkable. Therefore, the etiology of his status epilepticus was determined to be cerebral hypoxia from acute PE.

Patient was discharged home on postoperative day 2, on oral Apixaban and prophylactic Levotheram, and scheduled with outpatient follow-up with IE, Neurology, and Hematology.

On 1 month follow up visit, patient was doing clinically well with no dyspnea, vitals and hematologic lab values were within normal limits. Per hematology, since he suffered a provoked PE post orthopedic surgery he did not have hypercoagulable work-up. Plan was to continue anticoagulation with Apixaban for 6 months.

Discussion
This patient presented in the subacute post-operative period from a major orthopedic surgery, with a provoked intermediate-high risk saddle PE, causing profound cerebral hypoxia leading to status epilepticus and questionable cerebral ischemia/infarct, and thus thrombectomy were contraindicated due to an unpredictably high bleeding risk.

PE remains a serious condition with high mortality rates despite several treatment options. Large bore mechanical and aspiration thrombectomy has been shown to be safe and effective in patients with acute intermediate-risk PE, with the potential for immediate improvement in cardiovascular status, single session thrombus removal obviating thrombolysis, and reduced need for post-procedural clinical care.

This case is a great example of immediate repercussion with aspiration thrombectomy allowing for clinical improvement demonstrated by various invasive hemodynamic measures (Table 1) reduced pulmonary artery pressures, end tidal CO2, and improved cardiac index.

Intermediate-risk PE patients have worse outcomes yet invasive hemodynamics are not commonly measured. In one multicenter prospective cohort study, it was noted in 92 patients with intermediate-risk PE who underwent catheter directed thrombolysis (CDT) that there was not a strong correlation between invasive hemodynamic measurements (CI and PA pressures) and non-invasive measures (heart rate, blood pressure, or PESI score). Specifically, forty percent of patients who had a reduced CI, actually had relatively normal non-invasive measures. This treatment of these patients with CDT lead to significant hemodynamic improvements. Thus, invasive hemodynamics may help better identify and guide therapy for select intermediate-risk PE patients.

References

Fig 1. CTA chest demonstrating large saddle PE (left) with evidence of right heart strain - RV/LV ratio of 1.9 (right).

Fig 2. Using Triever16 through the Triever24 catheter in telescoping fashion to gain access into the inferior lobar branch of right pulmonary artery.

Fig 3. Triever20 curved catheter was inserted through the Triever24 catheter to gain access into the inferior lobar branch of the left pulmonary artery.

Fig 4. Initial pulmonary angiogram demonstrates expected large saddle embolus extending into distal aspects of the right and left main pulmonary arteries.

Fig 5. Final pulmonary angiogram demonstrates significant resolution of clot burden and improved pulmonary perfusion.

Table 1. Pre and post intervention invasive hemodynamic measures demonstrate immediate clinical improvement after reperfusion with aspiration thrombectomy.

<table>
<thead>
<tr>
<th>Blood Pressure (mmHg)</th>
<th>PA pressures (mmHg)</th>
<th>Cardiac Index (L/min/m^2)</th>
<th>Cardiac Output (L/min)</th>
<th>Stroke Volume (ml/bol)</th>
<th>End Tidal CO2 (mmHg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-aspiration</td>
<td>93/56</td>
<td>36/13 (Mean 24)</td>
<td>3.1</td>
<td>6.2</td>
<td>75</td>
</tr>
<tr>
<td>Post-aspiration</td>
<td>108/69</td>
<td>30/9 (Mean 18)</td>
<td>9.1</td>
<td>3.9</td>
<td>47</td>
</tr>
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