CATHETER DIRECTED PULMONARY ARTERY THROMBOLYSIS IN A COVID-19 POSITIVE PATIENT WITH MASSIVE PULMONARY EMBOLISM: CASE MANAGEMENT AND ENDOVASCULAR SUITE WORKFLOW IN A PANDEMIC

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ABSTRACT
Thromboembolic complications are common amongst cases of COVID-19 infections. This occurrence has seen a key role of endovascular treatment in the management of this potentially fatal complication. Endovascular thrombectomy or catheter directed thrombolysis is a fast and effective method for treatment of pulmonary embolisms, especially in a pandemic. We describe a case of COVD-19 complicated with massive pulmonary embolism treated with catheter directed thrombolysis-discussing case management, patient workflow and safety measures that should be strictly adhered to ensure a favorable outcome and ensure safety of treating personnel.

Keywords: COVID-19, pulmonary embolism, catheter directed thrombolysis

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1. INTRODUCTION

The COVID-19 infection is causing a large strain on the healthcare system worldwide. Total deaths from the disease till April 2020 were over a quarter million individuals[1]. High-risk groups include old age, those with underlying co-morbid disease and immunosuppression. Complications in COVID-19 infection include respiratory failure, pneumonia, acute respiratory distress syndrome as well as thromboembolic disease[2]. Of these complications, massive/sub-massive pulmonary embolisms is a potentially fatal sequelae in cases of COVID-19 [3], [4].

Endovascular treatment for cases of COVID-19 is crucial in the management of thromboembolic complications[5]. Endovascular approach to treatment and prevention of pulmonary venous thromboembolic complications is more feasible as opposed to open surgery in a pandemic. We report a case of catheter directed thrombolysis for a massive pulmonary embolism in a COVID-19 positive patient and discuss the treatment, outcome and workflow process in an endovascular suite.

2. CLINICAL HISTORY

A 71years old gentleman presented to the emergency department with a history of non-productive cough for 1 week prior to admission. His admission physical examination revealed stable vital signs with no evidence of fever or rapid breathing. His lung examination showed equal air entry with no abnormal breath sounds. His COVID-19 PCR swab was positive from a screening of an infected community cluster and he was classified as COVID-19 clinical stage 2A[6]. He had multiple comorbidities that included type 2 diabetes on subcutaneous insulin and single oral hypoglycemic agent, hypertension on dual antihypertensives and ischemic heart disease with a previous history of a coronary bypass in 2014. On day 2 of admission, he developed a temperature of 38 degrees but had no respiratory symptoms, escalating him to clinical stage 2B. He subsequently had breathing difficulties on day 3 of admission that required supplemental oxygenation. Clinical examination showed lung crepitations on auscultation with deranged blood gas, thus escalating him to clinical stage 4A.

However, at day 5 of admission, his blood oxygenation deteriorated further requiring invasive oxygen therapy and thus was intubated. Chest radiograph showed worsening lung infiltrates. A CT Pulmonary Angiography was performed at day 14 and revealed bilateral pulmonary embolism involving the main pulmonary trunks (right > left) with an enlarged right ventricle (Figure 1).

Due to the presence of massive pulmonary embolism, the decision was made to proceed with a catheter directed pulmonary embolectomy. A transfemoral venous access was used. Under ultrasound guidance, a 5 Fr x 10cm arterial sheath (Terumo Inc) was inserted into the right femoral vein. Using a 0.035" x 150 cm Glidewire (Terumo Inc), a 5Fr Sim2 (Cordis Inc) was guided into the main pulmonary trunk. Subsequently, the glidewire was exchanged out with a 0.035" x 300cm Amplatz super stiff guidewire (Cook Inc) and the Sim2 catheter was exchanged with a 5Fr Pigtail tip catheter (Cordis Inc).

A pulmonary angiogram was performed and demonstrated a large significant clot in the right main pulmonary artery with non-opacification of the right middle lobe branch (Figure 2a). Post angiography, the pigtail catheter was then advanced into the right pulmonary artery clot and the clot laced with 5mg r-TPA over 5 minutes. Subsequently, the pigtail was parked within the proximal aspect of the right main pulmonary artery clot and an r-TPA infusion of 1mg per hour was given over 24 hours.

Twenty-four hours post infusion, a repeat pulmonary angiogram showed significant reduction in clot burden within residual clot in the upper lobe pulmonary arterial branch (Figure 2b). No further bolus or infusions of r-TPA were given.

There was a transient improvement in the oxygenation in days following the procedure. However, the parenchymal disease from the COVID-19 infection had caused further lung failure. The patient finally succumbed to the illness after day 26 of admission. The cause of death was labelled as acute respiratory distress syndrome due to pneumonia due to COVID-19.

3. DISCUSSION

In the wake of the COVID-19 pandemic in 2020, every discipline has required to adjust and modify their daily practices in patient management. Patients would need to be managed on a case to case basis with a multidisciplinary decision and approach. As much as patient safety is the primary concern in treatment, today we need to address physician safety as a major highlight to case management. This is especially true in the surgical and endovascular based setting- where there are potential prolonged periods of multi personnel exposure in a confined space. Therefore, specific workflows and strategies are required to ensure the necessary safety measures are taken.

Case management approach

The risk of thromboembolic disease has shown to be increased in cases with COVID-19. Like in most large tertiary facilities, the option for surgical/endovascular management of pulmonary embolism is feasible to reduce mortality[7]. In this case, there was a massive pulmonary embolism with significant clot burden causing hypotension (requiring inotropic support), poor oxygenation and right heart strain.

Endovascular options for treatment in sub massive or massive pulmonary embolism are either catheter thrombectomy or catheter directed thrombolysis[5]. In our scenario, we opted for a catheter directed thrombolysis as we did not have suitable equipment for a catheter thrombectomy. This approach is a little unconventional as the patient would need a procedure done twice, 24-hours apart. This approach doubles the risk of exposure to personnel involved. However, the advantage of a catheter directed thrombolysis is a relative short procedural time- as there is less time spent in directing catheters to individual branches and repeated passes for clot retrieval.

In our case, a femoral venous approach is superior to a jugular approach as the operator would be further away from the potential source of an airborne infection. The use of a long sheath does facilitate easy repeated access especially in cases of a thrombectomy but was not used in our patient. There was significant reduction in clot burden on angiographic images 24 hours apart indicating success in clot lysis.

Angiographic workflow and room preparation

Most large infectious disease centers should have designated angiographic suites able to deal with potential epidemics. Negative pressure rooms with hepa-filters are critical to ensure a safe working environment for involved personnel. Having an airlock room or a double door access to the endovascular suite is advantageous. All non-essential mobile equipment should be removed prior to a case. Any equipment that cannot be removed (i.e. fixed cabinets, monitors, injectors) as well as parts of the angiographic/ anesthetic equipment should be covered in easy to remove plastic wraps. Clearly marked pathways with minimal or no contact with non-essential individuals should be visible to ensure fast and safe patient transport.

Cases are best to be deferred to a time whereby there are minimum staff within the units. The bare minimum workforce required for the case should be present in the endovascular suite to reduce potential exposure. All personnel in the suite are required to wear Personal Protective Equipment (PPE) as pertaining to recommendations for management of airborne droplet disease[8]. Some institutions may have the luxury of a Power Air Purifying Respirator (PAPR) for use and is recommended when performing procedures that can potentially aerosolize droplets.

A member of staff that is deemed 'clean personnel' is present outside the room (usually in the control room) and able to visualize the case through a glass panel. This 'clean personnel' will be able to trouble shoot and post process angiographic images throughout the case. He/she will also serve as a runner to provide any further equipment needed by the treating team via an airlock room/ dual entry point clean room.

After donning the required PPEs, the anesthetic team is informed and the case is brought to the endovascular suite. In our institution, there are 2-3 individuals who are involved in patient transport. In some centers, patient transport is done in a surgical isolation bubble transport. The endovascular suite remains closed off throughout the case. The receiving team should be geared and ready to receive the patient and help set up the individual monitors, tubes and etc. to minimize time in the endovascular suite.

During the procedure, any attempt to reintubate, or readjust the endotracheal tube should be done so with caution as the droplets could potentially aerosolize and may be harmful in endovascular suites not equipped with negative pressure. The angiography suite manager should have

discussions with the engineering teams to ensure the safety of performing aerosolized procedures in the room.

Once the case is completed, the patient is transported back to the ward and the terminal cleaning process is done. Thorough wipe down of all plastic surfaces are required with germicidal wipes that cover viruses. Non-alcohol based germicidal wipes are used for the ultrasound probes to protect the detector surface. All previous plastics covering equipment should be removed slowly and in a careful manner as to avoid any aerosolization of potential droplets on its surface and discarded. After removal, these surfaces should also be wiped down with germicidal wipes. Post terminal cleaning, the room is treated with an Ultra-violet light for 4-6 hours to kill any potential virus on surfaces not able to be cleaned (i.e. crevices, monitors etc.).

All staff involved in the case should then perform doffing and proceed to take a shower and discard all clothes. Lead-gowns should be given a wipe down with suitable germicidal wipes. Image post processing and data management should be done by the 'clean personnel'.

Staff should monitor themselves for the next 2 weeks to ensure no symptoms of fever or upper respiratory tract infection that may alert to a potential early infection. If present, they should immediately be screened, seek treatment and isolate.

4. CONCLUSION

Endovascular treatment of pulmonary embolism is a good option of treatment for thromboembolic complications associated with COVID-19 disease provided there are good workflows, physician and patient safety adherence as well as cleaning protocols to prevent contamination.

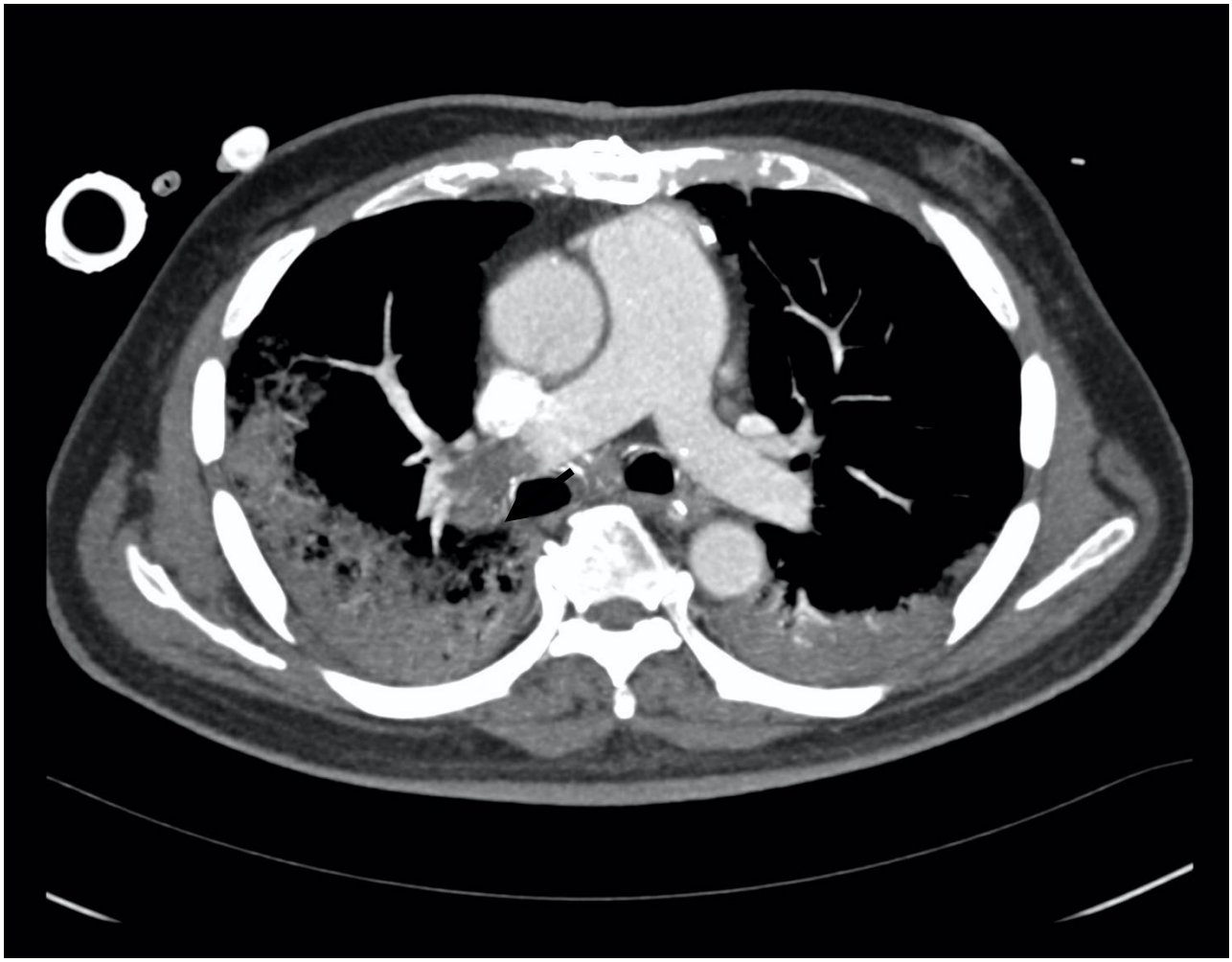

Figure 1: CT Pulmonary angiography shows large clot burden in right main pulmonary artery (black arrow) with underlying bilateral posterior and lower lobe consolidations. Clot in distal left pulmonary artery not seen here.

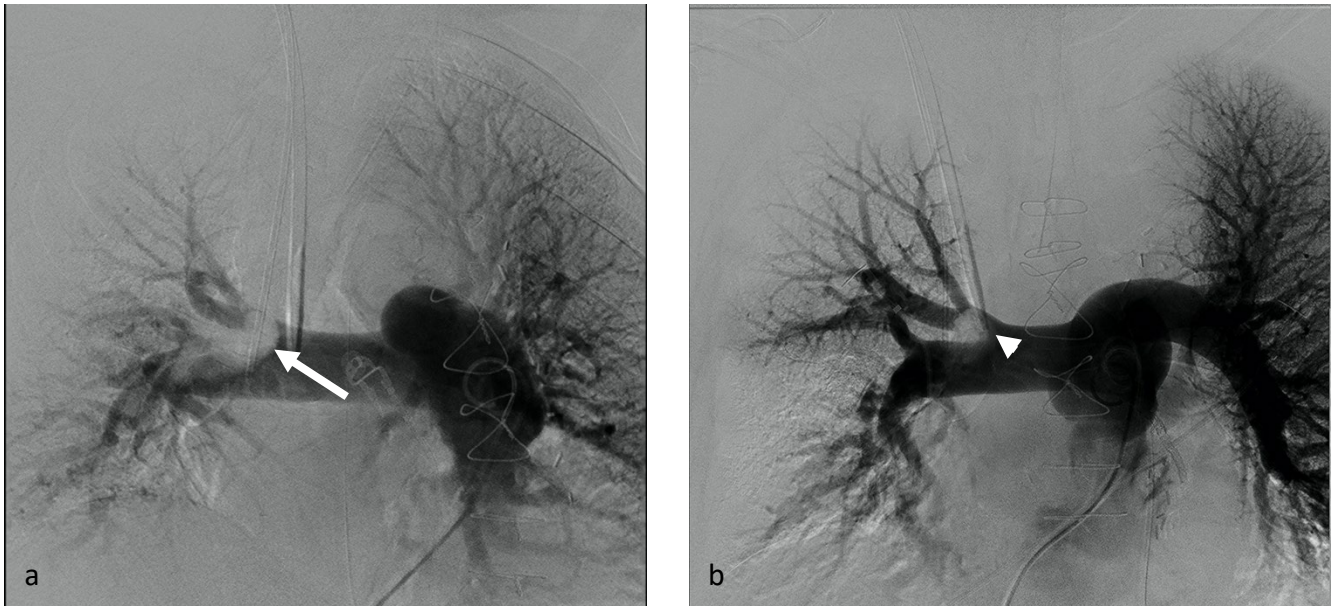

Figure 2a and 2b: Pulmonary angiograms with large filling defect in the right main pulmonary artery (white arrow). 24 hours post thrombolysis the clot has resolved with minimal residual clot in the right upper lobe (white arrowhead).

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