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Editorial

Editorial: Catheter interventions for massive pulmonary embolisms

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Recently, there have been various improvements in the methods used to diagnose and treat acute pulmonary embolisms (PE). The severity of acute PE depends on the size of the affected pulmonary artery, and acute massive PE, which results in a reduction in the volume of circulating blood due to right ventricular failure caused by vessel obstruction-induced right ventricular pressure overload, is a common life-threatening condition [1]. In cases of massive PE involving hemodynamic shock and instability, emergency resuscitation with vasopressor therapy and mechanical ventilation might be necessary together with the concomitant administration of anticoagulants, and in severe cases in which the patient collapses percutaneous cardiopulmonary support should be performed promptly. The optimal life-saving treatment for patients that suffer massive PE is to recanalize the obstructed pulmonary arteries as promptly as possible. Catheter interventions have been reported to be the best method for achieving this, as they are better at achieving rapid hemodynamic improvements than thrombolytic therapy alone [2,3]. Catheter interventions are also to fragment thrombi in order to increase their surface area, which makes them more susceptible to intrinsic or pharmacologic thrombolysis. Surgical embolectomy is an excellent treatment option for serious cases of PE [4]; however, its indications depend on the inherent risk and limitations of the procedure.

Aspiration using a 7 or 8 Fr end-hole catheter, such as a Judkins right catheter, is commonly achieved by manually applying negative pressure with an aspiration syringe. Aspiration is possible in locations where the catheter is able to pass through the thrombus and is used to treat the distal sections of blood vessels. It can also be used to treat distal emboli after different catheter interventions have been used to treat thrombi in proximal regions. An aspiration device, the Aspirex catheter (Straub Medical; Wangs, Switzerland), which has a screw rotating at 40,000 rpm within its lumen, enables the user to fragment and aspirate thrombus while the catheter is advanced into the thrombus and withdrawn during aspiration [5]; however, it is not available in Japan.

It has been reported that rotating a pigtail-catheter is effective at fragmenting thrombi [6]. Such procedures are performed as follows: a 0.035-inch guidewire is passed through the embolic occlusion. Then, the guidewire is passed through the pigtail catheter's end-hole, and the tip of the pigtail catheter is advanced over the wire into the occluded region. Next, the catheter's shaft is rotated manually while its pigtail is slowly advanced into the occlusion over the guidewire and then withdrawn. The curled tips of standard pigtail catheters have diameters ranging from 6 to 10 mm. Catheters whose curled tips measure 10 mm in diameter can only be used at proximal sites in the pulmonary arteries, and catheters with smaller pigtails are used at distal sites [7]. Another useful catheter intervention for clot fragmentation is balloon dilation angioplasty. However, in this procedure there is a risk of the wire and balloon migrating into small branches of the target artery, and it is difficult to estimate the diameters of thrombus-containing vessels, so balloons with smaller diameters than the target vessel should be chosen to prevent vascular perforation during the dilation of the balloon. Mori et al. [8] reported that balloon dilation using a 7 Fr Swan-Ganz catheter effectively fragmented thrombi in proximal pulmonary arteries. In their method, the balloon was positioned in the target vessel by advancing a guidewire through the occlusion and then sliding a catheter carrying the balloon over it. Furthermore, they suggested that detailed angiographic examinations of the balloon's location were necessary to prevent small vessels being overdilated, which can result in vascular perforation. In cases in which it is necessary to fragment thrombi in more peripheral arteries, it is important to check the position of the target vessel and estimate its diameter. One safe and effective method of assessing vessel location and diameter is to pass a diagnostic catheter through the embolic occlusion and visualize the target vessel by injecting 1 or 2 ml of contrast dye [9]. In addition, checking the diameters of vessels using intravascular ultrasound examinations before the procedure might allow the dilation site to be moved to a more distal one. Mori et al. performed selective pulmonary arteriography using a Swan-Ganz catheter and showed the position of its balloon, therefore, if the required assessments of occluded vessels are to be acceptable, the procedure is beneficial also from viewpoints of shortening of procedure time and decreasing cost, as they suggested.

One disadvantage of thrombolytic therapy is that it takes a long time to resolve thrombi; however, in patients that are not contraindicated for thrombolysis, thrombolytic therapy can be used in combination with catheter interventions. Systemic thrombolytic therapy can be performed before or after catheter interventions, and local thrombolytic therapy, in which fibrinolytic drugs are

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delivered directly to thrombi, is performed during catheter interventions. Combined treatment with thrombolytic therapy and catheter interventions is more reliable in cases of massive PE [7,10], as it rapidly improves the patient's hemodynamics and is able to quickly lyse large thrombi. Ultrasound-accelerated thrombolysis (USAT) is another catheter intervention; however, it is not available in Japan. In this technique, a catheter system is used to deliver microsonic energy to thrombi, which enhances fibrinolysis by causing reversible disaggregation of uncrosslinked fibrin fibers. Thereby, the thrombus permeability of thrombolytic drugs is increased. In addition, it has been reported that USAT rapidly reduces right ventricular dilation and the pulmonary clot burden, resulting in the restoration of cardiopulmonary function, whilst carrying a minimal risk of bleeding [11].

Catheter interventions are minimally invasive alternatives to surgical embolectomy for treating massive PE and have the advantage that they can be performed soon after diagnosis and completed within a short time. There are various catheter intervention methods, and multiple procedures can be combined to achieve good outcomes. In addition, they can also be combined with thrombolytic therapy. It is important to assess the results of such treatments at each stage and escalate the planned therapy if necessary; therefore, clinicians should aim to become familiar with each type of treatment.

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