MRI based Monitoring of Intervention for Deep Vein Thrombosis

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Introduction

Recently, the value of a gadolinium based fibrin-specific contrast agent (EP-2104R; Epix Pharmaceutics, Cambridge, MA, USA) has been demonstrated in several animal studies for molecular MR imaging to detect blood thrombi in coronary, pulmonary, and carotid arteries as well as in the left atrium (1-5). In these studies a fairly low dose of the novel fibrin-specific contrast agent allowed for selective and high-contrast delineation of fresh and chronic thrombi.

In the current study, the effectiveness of EP-2104R was investigated for visualizing thrombi within the venous system. As EP-2104R selectively binds to fibrin including thrombi, we sought to monitor percutaneous thrombectomy to recanalize occluded vessels in a swine model.

Materials and Methods

Deep vein thrombosis (DVT) was induced in 6 domestic swine using an occlusion-balloon catheter and subsequent injection of thrombin distal to the occluded vessel site. EP-2104R (4.0 µmol per kg body weight) was admistered systematically. Afterwards, occluded iliac veins were recanalized using a *Fogarty* catheter (n=3) and an *Arrow* rotating thrombectomy device (n=3). MR imaging of the pelvis and the lung was repeated four times (before and after DVT induction, after contrast agent administration, and after intervention) on a 1.5 Tesla whole-body XMR system (Achieva, Philips Medical Systems, Best, NL). The XMR system is equipped with a C-bow flueroscope, which allowed for MR imaging and fluoeroscopic imaging without any change to the postion of the study subject. Contrast enhancement was visualized using a T1 weighed gradient-recalled-echo (GRE) sequence.

Results

DVT induction was successfully performed in all 6 animals as confirmed by MR imaging and X-ray phlebography. Hereby, EP-2104R allowed for high-contrast visualization of the thrombotic material and for clear determination of the extent of the DVT (Fig. 1). Using a *Fogarty* catheter and the *Arrow* rotating thrombectomy device occluded iliac veins were recanalized in all cases. The removed thrombi with attached EP-2104R were found in the lung while the size of thrombi in the lung varied depending on the used thrombectomy device (i.e. long fragments using the *Fogarty* catheter, short fragments using the *Arrow* device), (Fig. 2 and 3).

Conclusion

MR imaging using the fibrin-specific contrast agent EP-2104R allowed for selective and high-contrast visualization of DVT. During subsequent percutaneous thrombectomy, remaining thrombus in the iliac veins as well as displaced thrombus in the lung was delineated with bright signal.

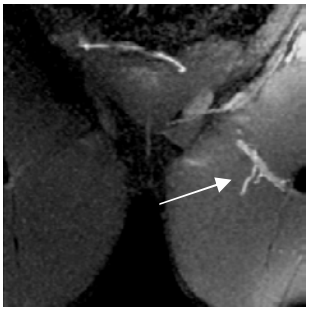

Fig. 1: High-contrast visualization of a thrombus in the left iliac vein after EP-2104R application. Note the small side branch, which is also filled with thrombotic material.

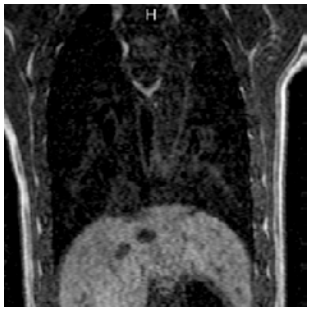

Fig. 2a: Pre contrast image of the lung after percutaneous thrombectomy was performed using the *Fogarty* catheter.

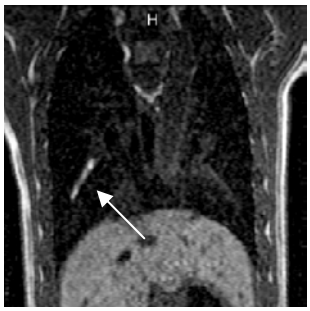

Fig. 2b: Post contrast image of the lung at the same position as in Fig. 2a shows a big thrombus fragment with bright signal in the right lower lobe.

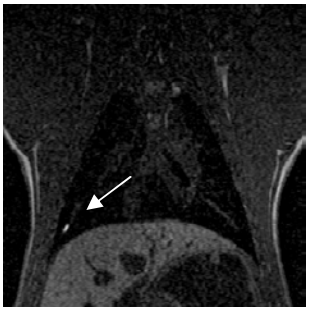

Fig. 3: Post contrast image of the lung after percutaneous thrombectomy was performed using the Arrow rotating thrombectomy device. One very small thrombus fragment was found in the periphery of the right lower lobe.

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