Use of a Temporary Caval Filter in A Young Man with Pulmonary Embolism to Prevent Migration of Massive Caval Thrombus During an Attempt of Caval Thrombolysis

Shunji Imanaka¹, Satomi Aihara¹, Kojiro Yoshihara¹, Akira Kato², Koichi Matsumoto², and Sho Kudo²

¹Department of General Medicine, and ²Department of Radiology, Saga Medical School, Saga, Japan

A 33-year-old male with no known risk factors for hypercoagulability developed a massive thrombus in the inferior vena cava (IVC). The patient had a history of both pulmonary embolism and embolism-related syncope. The thrombus which extended proximally to the level of the renal vein and distally to the left superficial femoral vein did not respond to anticoagulant therapy or thrombolysis. Thirteen days after admission, we decided to use a temporary caval filter to provide protection from migration of the thrombus while attempting invasive thrombolytic therapy, which was performed using a tissue-type plasminogen activator through a coaxial catheter of the temporary filter. This resulted in a marked decrease in the size of the thrombus, and multiple thrombi were found to be trapped in the temporary filter. Although the temporary caval filter was effective in capturing emboli, resulting in a decrease in the thrombus size, the thrombus was not completely dissolved within two weeks, which is the maximal implantation time. A permanent filter was eventually used to prevent pulmonary embolism, which could arise from the remaining thrombus. We have found placement of a temporary caval filter to be a safe and effective adjunct, in select cases, when attempting thrombolysis of massive thrombi in the IVC. Since we inserted the temporary filter 13 days after admission, use of a temporary filter during thrombolysis may have been more effective if conducted earlier in our patient’s clinical course. J Atheroscler Thromb, 2000; 6: 18-21.

Key words: Deep vein thrombosis, Pulmonary thromboembolism, Temporary/Permanent vena cava filter

Introduction

Pulmonary embolism (PE) is a major complication in patients with deep vein thrombosis (DVT). Management of patients with DVT requires anticoagulation and thrombolysis in select cases. Percutaneous placement of a permanent inferior vena cava (IVC) filter has also been used to supplement thrombolysis under certain circumstances. Concerns about possible long-term complications arising in younger patients or in patients with a long life expectancy have led to the development of both permanent filters that can be removed and temporary filters. Recently, in Japan, temporary IVC filters have become available for the prophylaxis of pulmonary embolism during attempts at thrombolysis. We report the use of a temporary caval filter during thrombolysis in a young male with massive DVT and previous history of PE to prevent thrombus migration.

Case Report

A 33-year-old man presented himself to our general outpatient clinic because of pain and swelling in his left inguinal region, accompanied by fever that had developed over a 1-week period. Symptoms such as cough,
dyspnea and chest pain were not noted. The swelling and tenderness over the left femoral vein was prominent. Ultrasonography of the left inguinal region demonstrated a hyperechoic structure which extended proximally to the level of the renal vein and caudally to the left superficial femoral vein. It was found to be a massive thrombus in the deep vein. The patient was immediately admitted for initial therapy and further evaluation.

On admission, his body temperature was 39.0°C, heart rate was 100/min and regular and blood pressure was 130/60 mm Hg and respiratory rate was 28. He was alert, not obese and normal vesicular breath sounds were audible. There was redness, swelling, warmth and tenderness over the left femoral vein as well as slight swelling of the left lower limb. Palpation of the peripheral arteries revealed normal pulsation. The results of laboratory data are shown in Table 1. Both prothrombin time and activated partial thromboplastin time were low-normal and the levels of antithrombin III, Protein C, Protein S and homocysteine were within normal limits and both anticardiolipin antibodies and lupus anticoagulant were negative. D-dimer levels, which are highly sensitive but not specific for the diagnosis of pulmonary embolism (1), were elevated. Blood cultures were all negative. Computed tomography (Fig. 1) showed areas of low attenuation inside the vein extending proximally to the renal vein junction and caudally to the left femoral vein. A large thrombus was the most likely diagnosis. High attenuation of soft tissue surrounding the thickened vein walls was considered associated inflammation. The possibility of a tumor developing inside the vein was excluded by both MRI studies and careful examination of possible primary sites. Lung perfusion scintigram (Fig. 2) revealed multiple bilateral defects, predominantly in the right lung, indicating the presence of multiple thrombi.

Immediately after admission, 5,000 units of intravenous low molecular weight heparin (L.M.W. heparin, Fragmin, Kissei Co. Ltd. Matsumoto, Japan) was administered. The patient’s fever, which seemed to be derived from phlebitis, resolved gradually. Although the patient was given antibiotics, his fever appeared to resolve on its own. An episode of syncope with convulsion had occurred two months before this admission, but had been diagnosed as epilepsy. In retrospect, the episode was most likely due to thromboembolism. Since the patient failed to respond to anticoagulation and non-invasive thrombolytic therapy, we attempted invasive thrombolytic therapy. Prior to initiating invasive thrombolytic therapy, we inserted a temporary filter (Antheor filter, Boston Scientific Corporation, Massachusetts, USA, Fig. 3) to protect against thrombus migration. The temporary filter was placed in the suprarenal region via the right brachial vein, and tissue-type plasminogen activator (t-PA) (Activacin, Kyowa Hakko Kogyo Co. Ltd., Tokyo, Japan) was administered at a dose of $600 \times 10^4$ U per day for 4 days starting 13 days after admission. Although the filter effectively trapped emboli during the thrombolysis procedure, resulting in a decrease in thrombus size (Fig. 4), the results were not satisfactory because some thrombus remained in the deep veins after nine days. Since two weeks is the maximal implantation time for a temporary filter, the temporary filter had to be removed and replaced with a
permanent filter. Prior to removal, inferior vena cavoography was performed, which revealed some thrombi trapped in the temporary filter. However, we determined that the trapped thrombi would not pose a problem during removal of the temporary filter. Before implantation of the permanent filter (Titanium Greenfield filter, Boston Scientific Corporation, Massachusetts, USA), the temporary filter was left in place to prevent the possible migration of the large thrombus. Venography was performed again and no new thrombi were found in the temporary filter. The temporary filter was then removed (Fig. 5) and replaced with the permanent filter suprarenally without complication. Warfarin was administered at a dose of 3.5 to 4.5 mg and the dosage was adjusted to maintain an international normalized ratio (INR) of 1.5 to 2.0. Intravenous L.M.W. heparin was administered for 26 days after implantation of the permanent filter. Laboratory data revealed a gradual increase in FDP-E concentration during the first two weeks, then normalization with levels of D-dimer, TAT and PIC. Two years after discharge, the patient is doing well without any complications from the permanent filter.

**Discussion**

This is a report of a young male with massive idiopathic DVT complicated by both pulmonary embolism and an episode of embolism-related syncope. We used a temporary filtering device during invasive thrombolytic therapy. Temporary filters have been available in Japan since February 1997. The Antheor filter system is placed via the brachial and femoral or jugular veins using a long catheter. The double-helix, biocarbon-coated basket, which is made of phynoxalloy, is positioned by the effect of the opening force on extrusion from a catheter pre-positioned over a guidewire and can be removed by exerting traction toward the catheter. The filter is 31 mm in diameter and 50 mm in length. It is a self-centering system, radiopaque and MRI compatible. The current indications for the placement of a temporary vena cava filter are as follows: 1) during thrombolysis of DVT; 2) as pre-operative prophylaxis (high risk orthopedic surgery and surgical interventions on a patient with a high risk for thrombolysis). Zwaan et al. evaluated the efficacy of three different kinds of temporary caval devices, including the Antheor filter, in 49 patients (2). None of the patients treated had clinically significant pulmonary embolism. Caval filter implantation led to three major complications, those related to baseline therapy, to filter implantation-related procedures, and to the filter implant itself. Complications from the filter were seen in two cases of clinically insignificant subclavian venous thrombus, one case of catheter-related infection, one case of insignificant filter displacement by mishandling, one case of torn basket filaments that could be extracted through the catheter and one case of air embolism, all of which were
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not lethal. Based on this evidence, the increasing use of temporary implants appears to be justified. In addition, there is little risk of complications from caval filters, such as filter migration or penetration. The use of a temporary filter provided significant benefits for the patient, as shown by the trapped thrombi in the removed filter, and there was a marked decrease in thrombus size. We have found that placement of a temporary caval filter can be a safe and effective adjunct during thrombolysis of massive thrombi in the IVC, in selected cases. Currently, temporary IVC filters are not widely used because of problems with trapped thrombus and in timing the removal of the filter. Mechanical extraction of thrombi trapped in the filter requires an exact evaluation of the remaining clot. Current data suggests that the filter can be safely removed when the thrombi are less than 1 cm³ in size. However, there are no radiological techniques to evaluate the size of the residual thrombus, forcing examiners to rely on their clinical judgment. Concerning the timing of removal, temporary vena cava filters are designed to remain implanted for a maximum of two weeks because the filter becomes covered by intima making extraction difficult after that time.

Current indications for placement of a permanent vena cava filter are as follows:

1) failure of anticoagulation to prevent recurrent embolism, 2) patients with venous thrombosis or pulmonary embolism who have contraindications to anti-coagulation or are difficult to manage on anti-coagulation, 3) patients with chronic recurrent pulmonary embolism with associated pulmonary hypertension and cor pulmonale, 4) following an episode of massive pulmonary embolism, 5) patients with DVT on anticoagulants who develop a complication forcing the discontinuation of anticoagulation (3-5).

In evaluating the use of a permanent filter in our patient, we considered the following problems. First, we had to consider the patient’s age. Most interventional radiology techniques are relatively new. However, permanent caval filters, especially the Greenfield type, have been available for approximately twenty-five years, serving as the gold standard. In patients younger than forty years old, there are several long-term safety issues to consider when deciding to use a permanent filter. Second, filters are usually placed below the level of the renal veins. However, Greenfield et al. reported that suprarenal placement of the Greenfield filter is safe and effective. There has not been any obstruction observed during the 16-year follow-up period for thrombus extending to the level of the renal veins or within those veins or for pregnant patients or women of child-bearing age (6).

After our report on permanent filter implantation in 1997, Decousus et al. (7) reported that in 400 patients with DVT, permanent inferior vena cava filters plus anticoagulation did not reduce the two-year mortality rate compared to that by anticoagulation alone. Our results suggest that temporary filters may be effective when trying to aggressively resolve the thrombus invasively. These results may have been more compelling if we had used the temporary filter earlier in the patient’s clinical course. Since we inserted the temporary filter 13 days after admission, we may not have gotten the full benefit of using the temporary filter.

Applications for vena cava filters have grown with improvements in percutaneous placement techniques, smaller catheter size, and experience in managing patients who need temporary and permanent IVC filters. Although the indications are limited, placement of a temporary caval filter is a safe and effective procedure in venous interventional radiology during thrombolysis for massive vein thrombosis.

References