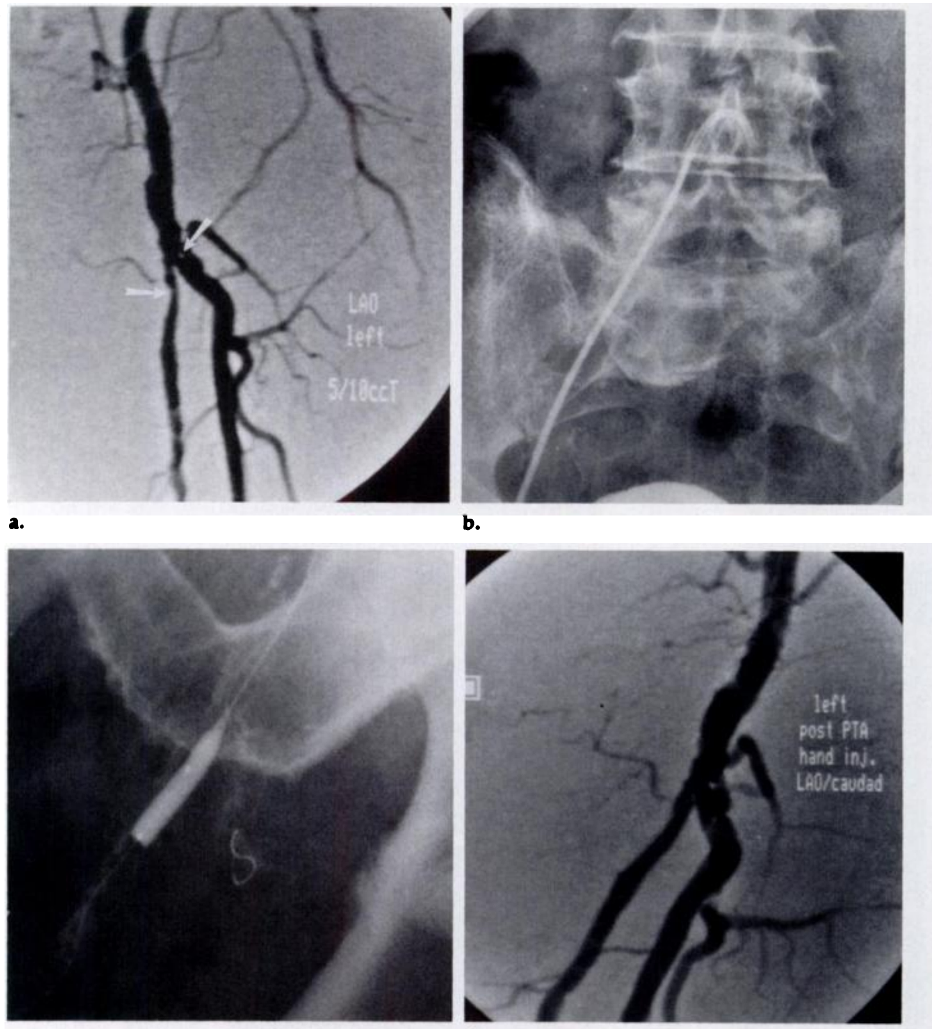

a. b. c. d.

Figure 2. **(a)** Digital arteriogram of the left femoral artery bifurcation shows stenoses at the origins of the deep and superficial femoral arteries (arrows). **(b)** Guiding catheter is directed over the aortic bifurcation. **(c)** The 0.014-inch-diameter guide wires placed through the guiding catheter are seen in the proximal deep and superficial femoral arteries. A 6-mm balloon catheter advanced over one of the wires is inflated in the superficial femoral artery. **(d)** Digital arteriogram obtained after angioplasty demonstrates improvement in the caliber of the stenotic segments.

of the superficial femoral artery when antegrade puncture of the ipsilateral common femoral artery was impossible. A stenosis in a renal transplant artery in a patient with an acute aortic bifurcation was also successfully dilated with the guiding catheter. ■

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MR Imaging of the Bird's Nest Filter[1]

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The appearance of the Bird's Nest inferior vena cava filter on magnetic resonance (MR) images of 11 patients is described. No complication or symptomatic filter displacement was encountered as a result of MR imaging performed at 1.5 T. The filters created significant local artifact and distortion on MR images. However, diagnostic MR images of the pelvis, spine, and brain may still be obtained.

Index terms: Magnetic resonance (MR), artifact, 982.1214 • Venae cavae, filters • Venae cavae, MR studies, 89.1214

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INFERIOR vena cava (IVC) filters are usually placed for long-term prevention of pulmonary thromboembolism. Currently, four IVC filters are commercially available in the United States: the Greenfield filter (Meditech/Boston Scientific, Watertown, Mass), the Bird's Nest filter (BNF) (Cook, Bloomington, Ind), the LGM filter (Vena-tech, Evanston, Ill), and the Simon nitinol filter (Nitinol Medical Technologies, Lincoln, Ill). Of these four filters, the BNF has been shown to be the most ferromagnetic (1). In light of the growing use of magnetic resonance (MR) imaging, the burgeoning use of the BNF, and the potentially harmful consequences of magnetically induced device dislodgment or migration, we describe our experience in imaging patients with previously placed BNFs. To our knowledge, MR imaging of patients with BNFs has not been previously described.

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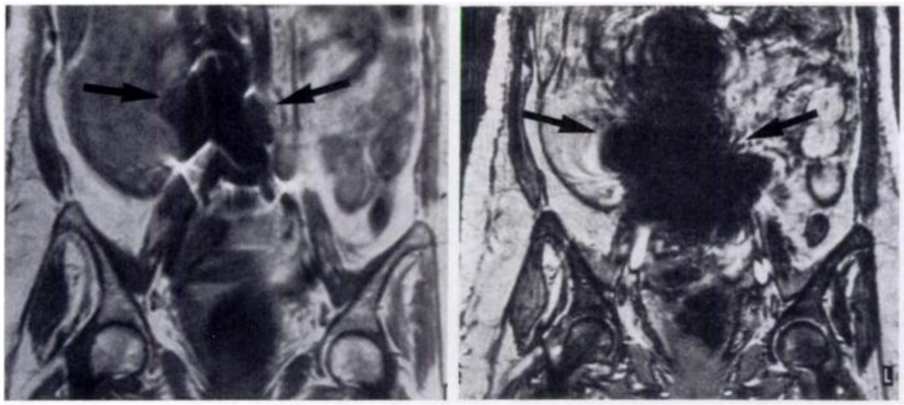
Materials and Methods

MR imaging was performed on 11 patients with previously placed BNFs. There were seven men and four women, ranging in age from 24 to 85 years (mean, 61.4 years). The filters were



1. 2.

Figures 1, 2. **(1)** T1-weighted spin-echo coronal MR image obtained at 1.5 T of patient with a BNF within the IVC shows metallic artifact (arrows) partially obscuring abdominal structures. **(2)** Coronal gradient-echo MR image of the same patient shows markedly increased artifact (arrows), compared with that on the spin-echo image.

placed for recurrent pulmonary embolus during adequate anticoagulation therapy or in cases in which anticoagulation therapy was contraindicated. MR images were obtained to assess abdominal tumors, spine lesions, and primary and secondary brain tumors. The MR studies were obtained 1 day (two patients) to several months (nine patients) following filter placement.

The patients were imaged on 1.5-T superconducting MR units (GE Medical Systems, Milwaukee; Philips Medical Systems, Shelton, Conn). MR imaging of the abdomen, pelvis, spine, and brain was performed with various spin-echo and gradient-echo sequences. No special consent was obtained in addition to the usual consent obtained at the time of any MR imaging study.

Abdominal radiographs were obtained in four patients before and after MR imaging.

Results

Filter artifacts were marked on spin-echo images (Fig 1) and appeared even more marked on the gradient-echo images (Fig 2). Although the diagnostic usefulness of abdominal MR images was limited due to the metallic artifacts, diagnostic images of the pelvis, brain, and spine were obtained. MR images of the brain were totally unaffected by the metallic filter. Abdominal radiographs obtained in four patients failed to demonstrate BNF migration after MR imaging. None of the patients had abdominal symptoms related to MR imaging. No complication or documented filter displacement was encountered as a result of MR imaging in any patient.

Discussion

Filter migration (2,3) and caval perforation (3,4) have been documented in some patients with previously placed Greenfield filters. Although filter migration has occurred in 1.1% of patients with the original (series I) BNFs (5), significant caval penetration or filter migration has not been reported in association with the currently available version (series II) of the BNF.

MR imaging of patients with indwelling Greenfield (6), Mobin-Uddin (American Edwards, Santa Ana, Calif) (7), and Simon nitinol filters (8) has been described and appears to be safe. However, MR imaging of patients with the BNF has not been reported, to our knowledge.

The BNF is significantly more ferromagnetic than the 316L stainless steel Greenfield filter. The LGM and Simon nitinol filters are nonmagnetic. Previous in vitro studies have shown that the BNF creates a more extensive magnetic susceptibility artifact than the Greenfield filter during MR imaging (1). This is, in part, related to differences in composition: The BNF is composed of 304 stainless steel alloy, which has a slightly lower nickel content than 316L stainless steel (9). Nickel stabilizes iron in a nonmagnetic state and reduces the formation of local ferromagnetic domains during the cold working necessary to produce different steel devices.

Despite the high degree of ferromagnetism displayed by the BNF in vitro, MR imaging of patients with the BNF appears to be safe at field strengths of up to 1.5 T. Our results agree with previous in vitro work demonstrating no migration of the BNF within a phantom IVC at 1.5 T (1). Any likelihood of filter migration induced by MR imaging would greatly decrease during the first several weeks following insertion, due to fibrin and neointimal accumulation at filter contact points along the caval luminal surface. Although the metallic artifacts created by the BNF do significantly degrade abdominal images, the filters do not appear to significantly interfere with the diagnostic usefulness of pelvic, spine, or brain MR images. ■

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