

Symptomatic duodenal perforation by a Bird's Nest vena cava filter

Anand Parikh, MD, Jason Zhang, BS, Julia Glaser, MD, and Venkat Kalapatapu, MD, Philadelphia, Pa

ABSTRACT

This case describes a patient with a permanent Bird's Nest inferior vena cava filter in the setting of spinal cord injury and paraplegia who presented with epigastric pain resulting from duodenal perforation of his filter. After confirming that the patient was stable hemodynamically with normal laboratory values, he underwent open exploration with trimming of the extraluminal struts and wires, leaving the intact filter in place, with resolution of his pain. Although percutaneous removal of inferior vena cava filters is preferred for retrievable filters, this case demonstrates the safety and efficacy of open surgical management for permanent filters, not designed for retrieval. (*J Vasc Surg Cases and Innovative Techniques* 2021;7:104-7.)

Keywords: Bird's Nest inferior vena cava filter; Duodenal perforation; Open repair; Symptomatic; Recurrent DVT

Pulmonary embolism (PE) is defined as an obstruction of the pulmonary arteries and is a significant cause of morbidity and mortality. Previous studies have estimated PEs causing 5%-10% of deaths in hospitalized patients.¹ PE is frequently a consequence of deep vein thrombosis (DVT), and trauma patients are especially at risk for DVT given potential vascular injury, immobility, and venous stasis.² Inferior vena cava (IVC) filters have been used for patients with DVT or PE who have either failed anticoagulation or have a contraindication for anticoagulation. Major trauma patients were considered reasonable candidates for IVC filters because of increased propensity for venous thromboembolism and contraindication for anticoagulation in the setting of major hemorrhage. However, recent studies have demonstrated that prophylactic placement of IVC filters for trauma patients at risk of DVT with contraindication for anticoagulation did not decrease the incidence of symptomatic PEs.^{3,4} Despite a paucity of literature demonstrating the efficacy of IVC filters, current American Heart Association guidelines recommend the use of filters in patients with acute DVT or PE with a

contraindication to anticoagulation and recommend prompt retrieval of removable filters.⁵

Complications of IVC filter placement include PE, access site thrombosis, filter migration, caval perforation, caval obstruction, and fracture.⁶ The true incidence of perforation is unknown due to the lack of routine monitoring. However, Jia et al⁷ found that perforation of the IVC by any type of IVC filter occurred at a frequency of 19%, with 8% of patients with penetration being symptomatic, in a MEDLINE database search including 9002 patients. In this study, we will discuss the treatment of a 33-year-old man with a history of DVT and Bird's Nest IVC filter (Cook Medical, Bloomington, Ind) placement with subsequent duodenal perforation. The patient consented to having his case details and images published.

CASE REPORT

The patient is a 33-year-old man with a history of gunshot wound 10 years ago complicated by liver laceration, spinal cord injury resulting in paraplegia and incontinence, and recurrent DVTs treated with a Bird's Nest IVC filter, who presents with 1 week of vague epigastric abdominal pain. The patient was not on anticoagulation at the time of presentation.

The patient presented with 1 week of worsening epigastric pain and nausea and was found on computed tomography scan to have the superomedial strut of his infrarenal Bird's Nest IVC filter eroded through the IVC into the second portion of the duodenum with penetration into the lumen of the duodenum (Fig 1). Computed tomography demonstrated paraduodenal inflammation but no extraluminal gas or collection. On presentation, he was hemodynamically stable, afebrile, and without elevated white blood cell count. Gastroenterology was consulted for esophagogastroduodenoscopy to evaluate the extent of duodenal injury; however, esophagogastroduodenoscopy was deferred because of concern for causing further injury with insufflation. The decision was made to proceed with an open intervention, and general surgery was consulted and available for duodenal repair if required.

From the Division of Vascular and Endovascular Surgery, Department of Surgery, Perelman School of Medicine, University of Pennsylvania.

Author conflict of interest: none.

This study was presented at the forty-first Annual Meeting of the Delaware Valley Vascular Society, Philadelphia, Pa, May 9, 2019.

Correspondence: Venkat Kalapatapu, MD, Division of Vascular Surgery, Perelman School of Medicine, University of Pennsylvania, 4 Maloney 3400 Spruce St, Philadelphia, PA 19104 (e-mail: venkat.kalapatapu@pennmedicine.upenn.edu).

The editors and reviewers of this article have no relevant financial relationships to disclose per the Journal policy that requires reviewers to decline review of any manuscript for which they may have a conflict of interest.

2468-4287

© 2020 The Author(s). Published by Elsevier Inc. on behalf of Society for Vascular Surgery. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

<https://doi.org/10.1016/j.jvscit.2020.11.007>



Fig 1. Perforation of the inferior vena cava (IVC) filter into the duodenum. On computed tomography, the superomedial strut of the Bird's Nest filter has eroded into the lumen of the second part of the duodenum (white arrow).

OPERATIVE PROCEDURE

The patient was taken to the operating room and a right subcostal incision was made with dissection carried down bluntly through the retroperitoneal space to expose the IVC. The length of infrarenal IVC containing the filter was dissected free, and the duodenum dissected sharply off the anterior surface of the IVC in the superior aspect of the wound. The eroded strut was identified exiting the IVC (Fig 2) and into the posterior wall of the duodenum where the strut was transected flush with the caval wall and extracted from the duodenum. No gross injury was identified on the posterior wall of the duodenum and no bile staining was noted within the wound; therefore, no duodenal repair was undertaken. In addition, all other extraluminal struts and Bird's Nest wires were trimmed flush with the caval wall using wire cutters ensuring that no sharp edges were left behind. The patient recovered well and had resolution of his epigastric pain before discharge on postoperative day 5. An abdominal radiograph was taken before discharge showing interval removal of filter struts (Fig 3). The patient was asymptomatic at 1 month postoperatively, and the plan was made to follow up as needed for clinical symptoms. No further imaging was recommended as the struts were removed flush with the caval wall and there was low concern for further penetration.

DISCUSSION

IVC filters are indicated for the prevention of life-threatening PEs in patients with DVT who either have a contraindication to anticoagulation or recurrent DVTs despite therapeutic anticoagulation. In the setting of the patient's paraplegia, abdominal trauma, and DVT at the time of his gunshot wound 10 years ago, the decision was made to place a permanent Bird's Nest IVC filter by an outside hospital. Although perforation is not an

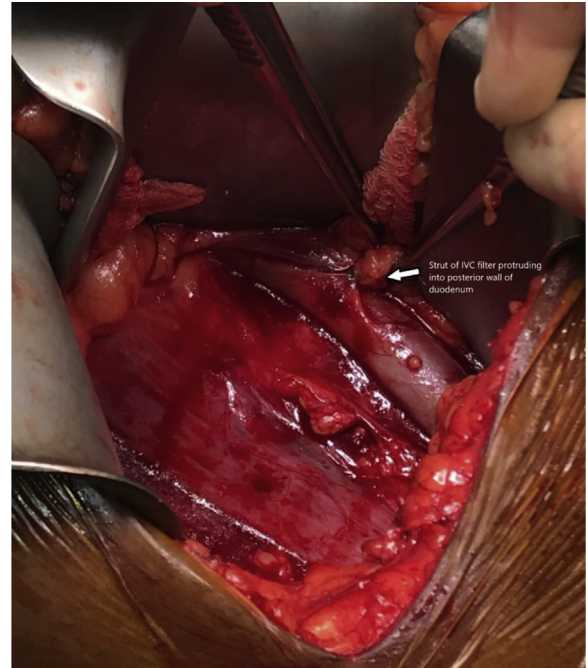


Fig 2. Eroded strut in the posterior wall of the duodenum. After exposure of the inferior vena cava (IVC), the eroded strut was visualized entering the duodenum. The strut was subsequently removed flush with the caval wall.

uncommon occurrence after any type of IVC filter placement (19%) as described by Jia et al,⁷ the rate of caval perforation by Bird's Nest filters has been documented to be 85% and 100% in separate small observational studies of 52 and 12 patients, respectively, though none were symptomatic.^{8,9} The true incidence is likely unknown due to the lack of imaging surveillance.

The Bird's Nest filter design consists of two rigid "V" shaped struts that anchor the filter mechanism, followed by four 2.5-cm-long stainless steel 0.018-inch wires that are coiled along the anchoring mechanism within the cava to create a wire mesh filter.¹⁰ Although complete surgical removal of the Bird's Nest filters has been performed,^{11,12} this is difficult because of the filter's permanent nature and long length, and complete removal risks tearing the cava during attempts at extraction due to the rigid nature of their anchoring mechanism and extensive nature of the stainless steel wires.¹³ Therefore, several studies with perforation have left the Bird's Nest filter in place and instead trimmed the protruding struts flush with the caval wall such as in our case.¹⁴⁻¹⁶

Of those with IVC filter perforation from any type of filter who present with symptoms, nearly 80% demonstrate radiographic evidence of surrounding organ penetration.⁷ Specifically for Bird's Nest filters, several reports exist in the literature for visceral perforation including renal, duodenum, and hepatic.^{11,12,14-17} Several cases of duodenal perforation resulted in gastrointestinal bleeding and were subsequently treated by trimming

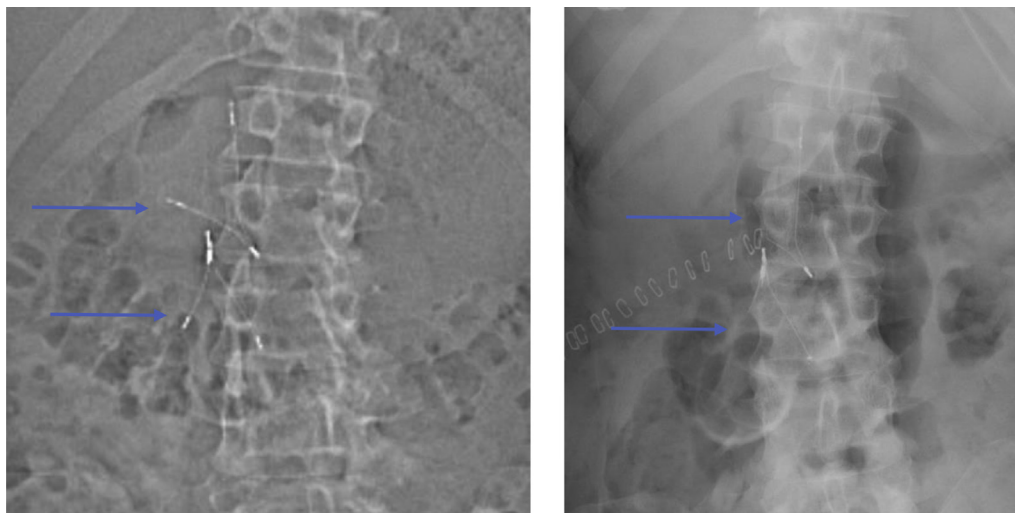


Fig 3. Removal of Bird's Eye filter struts. An abdominal X ray taken the day before discharge (right) showed a smaller length of struts secondary to surgical removal when compared with scout film from computed tomography on admission (left).

protruding struts in addition to duodenal repair and omental patch.^{14,15} We did not consider an omental patch in our case because duodenal repair was not needed and there was no evidence of bile staining or spillage of contents. A more potentially serious complication is the migration of the filter into the adjacent aorta and right atrium, which has been documented as well, resulting in pseudoaneurysm and death, respectively.^{18,19}

An additional concern with complete filter removal in this patient is that he will remain high risk for recurrent DVT given his spinal cord injury and paraplegia, leaving him without protection against a potentially fatal PE. Thus, the decision was made to leave the filter and to instead cut all protruding metal struts and wires flush with the caval wall.

CONCLUSIONS

Though rare, duodenal perforation of a Bird's Nest IVC filter can present with abdominal pain. For patients who require long-term IVC filter placement, it is possible to remove offending wires and struts without surgical removal of the entire filter, with subsequent resolution of symptoms.

REFERENCES

- Essien EO, Rali P, Mathai SC. Pulmonary embolism. *Med Clin North Am* 2019;103:549-64.
- Ruskin KJ. Deep vein thrombosis and venous thromboembolism in trauma. *Curr Opin Anaesthesiol* 2018;31:215-8.
- Geerts WH, Code KI, Jay RM, Chen E, Szalai JP. A prospective study of venous thromboembolism after major trauma. *N Engl J Med* 1994;331:1601-6.
- Ho KM, Rao S, Honeybul S, Zellweger R, Wibrow B, Lipman J, et al. A multicenter trial of vena cava filters in severely injured patients. *N Engl J Med* 2019;381:328-37.
- Duffett L, Carrier M. Inferior vena cava filters. *J Thromb Haemost* 2017;15:3-12.
- Angel LF, Tapson V, Galgon RE, Restrepo MI, Kaufman J. Systematic review of the use of retrievable inferior vena cava filters. *J Vasc Interv Radiol* 2011;22:1522-30.
- Jia Z, Wu A, Tam M, Spain J, McKinney JM, Wang W. Caval penetration by inferior vena cava filters: a systematic literature review of clinical significance and management. *Circulation* 2015;132:944-52.
- Nicholson AA, Ettles DF, Paddon AJ, Dyet JF. Long-term follow-up of the Bird's Nest IVC Filter. *Clin Radiol* 1999;54:759-64.
- Starok MS, Common AA. Follow-up after insertion of Bird's Nest inferior vena caval filters. *Can Assoc Radiol J* 1996;47:189-94.
- Roehm JO Jr. The bird's nest filter: a new percutaneous transcatheter inferior vena cava filter. *J Vasc Surg* 1984;1:498-501.
- Capasso K, Awad NA, Alvarez N, Deutsch ER, Zaki R, Choudry RC. Urinary excretion after transcaval renal penetration of a fragmented Bird's Nest filter. *J Vasc Surg Venous Lymphat Disord* 2020 Apr 16. [E-pub ahead of print].
- Lee JS, Hwang JK, Park SC, Kim SD. Surgical removal of an inferior vena cava filter with duodenal penetration. *Interact Cardiovasc Thorac Surg* 2019;28:487-8.
- Qato K, Conway A, Fatakhova O, Nguyen N, Giangola G, Carroccio A. Various approaches to open removal of inferior vena cava filters. *Ann Vasc Surg* 2020;65:288.e9-14.
- Mansour JC, Lee FT Jr, Chen H, Turnipseed WD, Weber SM. Chronic abdominal pain and upper gastrointestinal bleeding due to duodenal perforation caused by migrated inferior vena cava filter—a case report. *Vasc Endovascular Surg* 2004;38:381-4.
- al Zahrani HA. Bird's nest inferior vena caval filter migration into the duodenum: a rare cause of upper gastrointestinal bleeding. *J Endovasc Surg* 1995;2:372-5.
- Feezor RJ, Huber TS, Welborn MB 3rd, Schell SR. Duodenal perforation with an inferior vena cava filter: an unusual cause of abdominal pain. *J Vasc Surg* 2002;35:1010-2.
- Greer G, Rinker E, Getzen T, Schwartz S. Transhepatic migration and transcutaneous expulsion of a fractured inferior vena cava filter. *J Vasc Med Biol* 2003;15:101-4.

- nest inferior vena cava filter strut: a case report. *J Vasc Interv Radiol* 2019;30:120-2.
18. Campbell JJ, Calcagno D. Aortic pseudoaneurysm from aortic penetration with a bird's nest vena cava filter. *J Vasc Surg* 2003;38:596-9.
 19. Urena R, Greenwood L. Bird's nest filter migration to the right atrium. *AJR Am J Roentgenol* 2004;183:1037-9.

Submitted Sep 17, 2020; accepted Nov 15, 2020.