

# Incidence and Implications of a Left Inferior Vena Cava on IVC filter placement

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## Abstract

**Objective:** To assess the prevalence and ability to detect a left inferior vena cava (IVC) during venography prior to filter placement and its implications for device implantation.

**Materials and Methods :** Over 58 months, patients referred for an IVC filter were prospectively evaluated for a left IVC by performing cavography injecting into the left iliac vein, left renal venography, or CT scan correlation. Additionally, cavograms of patients receiving filters over the four previous years were reviewed to assess the adequacy of detecting these anomalies based on the degree of opacification of the left iliac vein in relation to the position of the catheter tip.

**Results:** Prospective evaluation for a left IVC was adequate in 477 of 503 patients. Retrospective evaluation using CT scans was possible in another 14. Left IVCs were detected in 5 patients (1%). Three patients with duplications were managed with either 2 filters, a suprarenal filter, or a bird's nest filter straddling both cavas. Two patients with isolated left IVCs received a single filter. Of 62 retrospectively reviewed cavograms, the left iliac vein was inadequately opacified in 69% when the catheter was in the low IVC (53 patients) and 71% when it was in the right iliac vein (7 patients).

**Conclusions:** Low caval or right iliac vein injections infrequently provide sufficient reflux into the left iliac vein to assess for a left IVC. Left iliac vein catheterization is easy and will readily provide this information. Modifications in filter placement technique may be necessary when caval anomalies are present.

Ind J Radiol Imag 2005 15:2:277-280

**Keywords:** - Left IVC, IVC filter

## INTRODUCTION

Prior to placement of an inferior vena caval filter, it is customary for the radiologist to perform a preliminary inferior vena cavogram to assess the size of the inferior vena cava and the location of the renal veins, and to exclude pathology in the IVC. Previous studies have demonstrated that cavography provided important information in 15 to 26% of patients having filters placed (1,2) Cavography is also performed to exclude the presence of anomalous venous anatomy, such as caval duplication. In duplicated IVC the left cava arises from

the left common iliac vein and will only be visualized at cavography if the latter structure is adequately opacified with contrast. The examination is, however, usually performed with the catheter placed in the inferior aspect of the IVC or in the right common iliac vein. We believe that an important deficiency of this technique is that it may miss the presence of a clinically significant IVC duplication by inadequately opacifying the left common iliac vein.

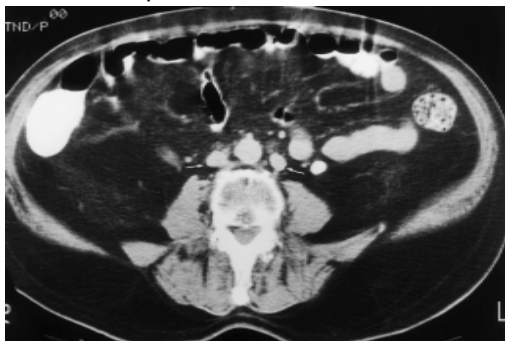


Figure 1. A) 72-year-old male with history of colon Ca, cavogram demonstrates caval duplication.



B) Bird's nest filter deployed by right femoral approach, first set of struts in left IVC, second set of struts in right IVC, with the threads straddling both cavae.

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Received 2 December 2004; Accepted 10 January 2005

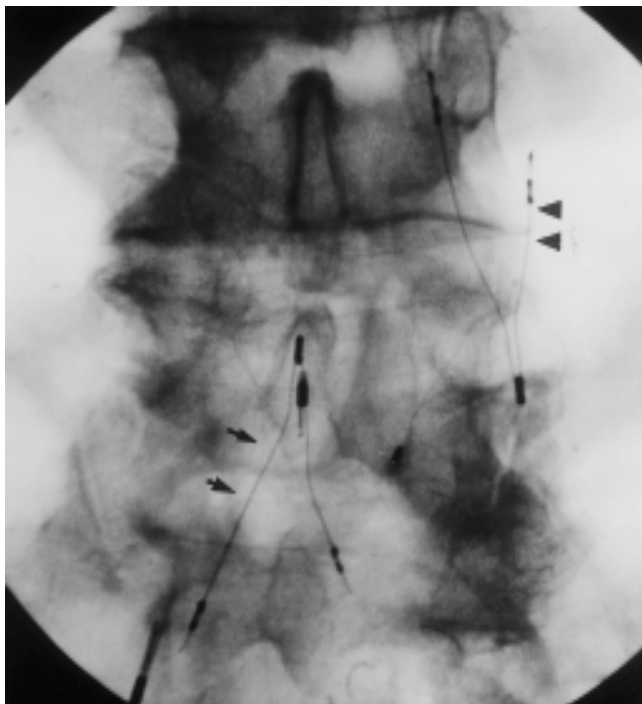


Figure 2. A) 71-year-old male with prostrate Ca resulting in colonic obstruction (hence residual colonic contrast); cavogram demonstrates duplicated IVC with thrombus in right cava.

B) Two Bird's nest filters deployed, one via right IJ approach in right IVC and one via left femoral approach in left IVC.

To better assess for the possible presence of a left IVC, we started to perform our cavograms by injecting directly into the left iliac vein. We also retrospectively reviewed cavograms performed with the catheter tip either in the low cava or the right iliac vein to assess the adequacy of opacification of the left iliac vein using this standard technique. Our objectives were a) to evaluate whether injecting contrast directly into the left common iliac vein results in better opacification of that structure than injecting into the IVC or right common iliac vein. b) to assess the incidence of caval duplication in a large series of patients and c) to review our experience with regard to the approach to IVC filter placement in those patients detected to have an anomalous IVC.

## MATERIALS AND METHODS

Cavograms performed at our institution prior to placement of an IVC filter are performed with the catheter tip in the left iliac vein. This is readily accomplished when using a right common femoral vein or internal jugular vein approach. When using a right femoral vein approach, a pigtail catheter is negotiated across the bifurcation either after advanced a wire into the left iliac vein or by directing it into the upper aspect of the left common iliac vein using the curved back end of a wire and then stripping it off the wire further into the vein. A contrast injection is then performed. Cavograms performed using this technique were prospectively evaluated for the presence of a caval duplication or a left IVC. On occasions where a prior CT scan was available to review for a left IVC, a left iliac vein injection was not done.

We also retrospectively evaluated the cavograms of the patients receiving IVC filters at our institution in which this specific procedure was not followed. These cavograms were reviewed by two radiologists (A.K., J.S.P.) for the location of the catheter tip and the degree of opacification of the left iliac vein. Opacification of the vein was considered to be adequate if at least 5 cm of the left common iliac vein was opacified with contrast. Any cross-sectional studies performed on these patients were also evaluated for the presence of any caval anomalies.

## RESULTS

62 cavograms using standard technique were retrospectively reviewed to assess for IVC anomalies. The catheter tip was in the inferior IVC in 53 patients, in the right iliac vein 7 patients, and in the left iliac vein in 2 patients. Adequate opacification was defined by us as contrast seen up to 5 cm from the iliac confluence. With the catheter tip in the inferior IVC, adequate opacification of the left iliac vein was observed in 16(31%) cases while in the remaining 37(69%), the left iliac vein was either unopacified or only minimally opacified. With the catheter tip in the right iliac vein, adequate opacification of the left

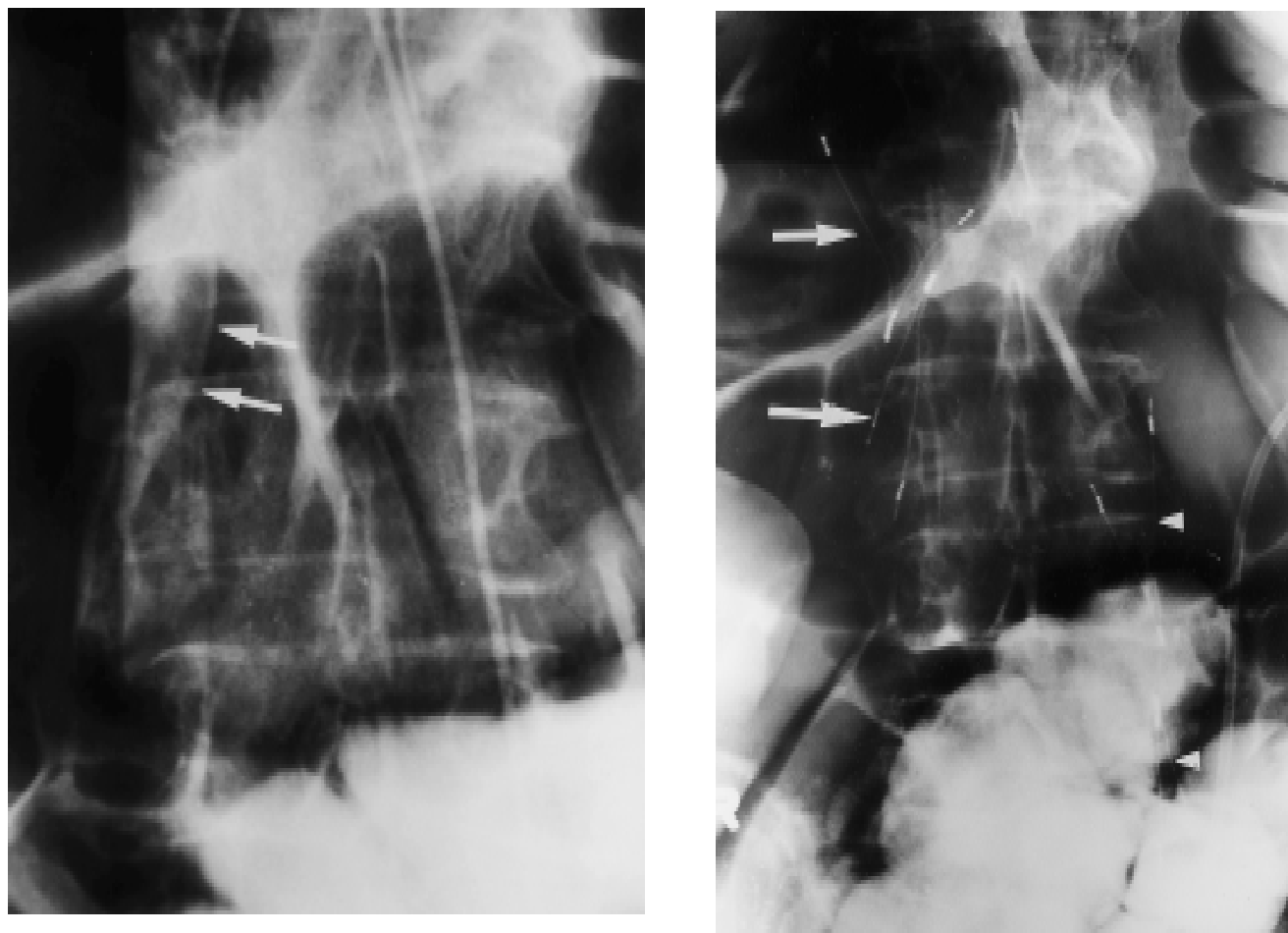


Figure 3. A) 52 year-old female; cavogram demonstrates caval duplication with thrombosed right cava (confirmed by probing right cava with Simmons catheter).

B) Titanium Greenfield placed in suprarenal location via right IJ route.

iliac vein was seen in 2(29%) of the patients, with 5(71%) demonstrating inadequate opacification.

A total of 503 cavograms were performed with the catheter tip in the left iliac vein. In all (100%) the left common iliac vein was well opacified. Five anomalies of the cava were observed in this group. Three (60%) of these were clinically significant and necessitated modification in the filter placement technique. The anomalies and the approach to filter placement employed in each case are listed in Table 1. Additional anomalies that were incidentally detected include accessory left renal veins in 3 patients.

Table 1

Catheter tip	Total cases	Left iliac vein opacified*	
		(+)	(-)
Inferior IVC	53	16 (31%)	37 (69%)
Right iliac vein	7	2(29%)	5(71%)
Left iliac vein	2	2(100%)	0(0%)
Total	62	20	42

\*Defined as opacification of at least the upper 5cm of this vein.

Table II

**Techniques of filter placement:**

-Case 1: Duplicated IVC	Two filters, one deployed in each cava.
-Case 2: Duplicated IVC	Single bird's nest filter.
-Case 3: Duplicated IVC	Single suprarenal filter.
-Case 4: Left IVC	Single filter in Lt IVC.
-Case 5: Left IVC	Single filter in Lt IVC.

**DISCUSSION**

Anomalies of the IVC are not uncommon, with caval duplication reported in 0.2-3.0% of the general population (3). Developmentally, caval duplication is the consequence of a persistent left supracardinal vein (4,5). This anomaly has significant implications for radiologists placing IVC filters, particularly with the increasing number of patients referred for this procedure (6). Our study detected 5 caval anomalies in a series of 503 consecutive patients, an incidence of 1%. Placement of a single infrarenal filter in a patient with IVC duplication can render the patient susceptible to recurrent episodes of pulmonary embolism.

Detection of these anomalies is therefore of importance, so that the technique of the filter placement may be appropriately modified (7-6).

The standard technique for cavography involves performing the contrast injection with the catheter tip in the lower IVC or the iliac vein on the side of the venous puncture, usually the right. A deficiency of this technique is its potential to miss a duplicate IVC. To circumvent this, resort is made to such techniques as having the patient perform a Valsalva maneuver at the time of the injection to opacify the contralateral iliac vein. However, with critically ill and uncooperative patients, this is frequently not an option. An alternative is to puncture the left femoral vein and perform the injection with the catheter in the left iliac vein (10), although right-handed radiologists tend to prefer the converse route for reasons of manual dexterity. Also, several of the commercially available filters are difficult to place into a normally positioned, right-sided cava by the left-sided route.

Our study demonstrates that with conventional methods of performing cavography with the catheter tip in the low IVC or right iliac vein there is inadequate opacification of the left iliac vein to allow for visualization of a left IVC in up to 71%. Prospective evaluation by passing the catheter over the bifurcation and the left iliac vein, on the other hand, results in the ability to confidently exclude the presence of this anomaly. While it is occasionally difficult to cross the ilio caval bifurcation from a right femoral vein approach using conventional wire and catheter manipulations, the use of the curved back end of a wire makes this maneuver quite easy and rapid. When approaching from the internal jugular vein, this selective catheter position is readily accomplished. In the setting of an occluded left iliac vein, the left renal vein can be probed for an accessory left IVC or a cross-sectional study of the abdomen can be obtained.

In summary, we believe that exclusion of inferior vena

caval duplication is a necessary part of the cavographic evaluation prior to filter placement. To reliably exclude this anomaly, we recommend that the contrast injection be performed with the catheter tip in the left common iliac vein.

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