The American Journal of Surgery (2015) ■, ■–■

The American Journal of Surgery®

Inferior vena cava filter placement at bedside using computed tomography scan information: a new technique for accurate deployment

Anil Srivastava, M.D.*, Bryan Troop, M.D., Ann Peick, M.D., Antoinette Kanne, R.N., M.S.N., C.N.S.

Division of Trauma/General Surgery, Mercy Hospital, Suite 560 A, 621 S. New Ballas Road, St. Louis, MO, 63141, USA

KEYWORDS:
Venous thromboembolism;
Bedside;
Inferior vena cava filter;
CT information based

Abstract

BACKGROUND: An inferior vena cava filter (IVCF) is indicated for the prophylaxis of pulmonary embolism where anticoagulation is contraindicated. The majority of these filters are placed using fluoroscopy and venogram. We hypothesized that a computed tomography (CT) scan of the abdomen and pelvis provides sufficient information for successful deployment of an IVCF at bedside without the need for any further imaging during the procedure.

METHODS: A retrospective review of prospectively collected data of a bedside IVCF placement technique using measurements from abdominal/pelvic CT scans without additional intraoperative imaging in 38 patients at a level 1 trauma center was conducted.

RESULTS: The most common indication for IVCF placement was high-risk patients without deep venous thrombosis. All these procedures were performed at bedside. Nonretrievable (TrapEase) and retrievable (OptEase) type filters were used. All these IVCFs were placed below the renal veins without any complications.

CONCLUSIONS: IVCFs can be placed based on measurements from abdominal CT scans without the need for further imaging such as fluoroscopy or an inferior vena cava venogram. This technique is as simple as bedside femoral venous line placement.

Venous thromboembolism (VTE) is a major cause of cardiovascular morbidity and mortality.[1] Incidence of VTE in trauma patients is very high. One autopsy study reported a 63% incidence of deep venous thrombosis (DVT) or pulmonary embolism (PE) among trauma patients.[2] Anticoagulation is the first line of prophylaxis and treatment of VTE.[3]

Inferior vena cava filter (IVCF) placements are indicated in patients with PE and in high risk patients for DVT, where anticoagulation is contraindicated.[4–6] Before the deployment of filters, it is essential to evaluate the anatomy of the inferior vena cava (IVC) with special reference to the diameter of the vena cava, the position of the renal vein, and the venous anomalies.[7–9] In current practice, to obtain this information, patients are taken to the angiography suite or the operating room where they undergo an intraoperative vena cava venogram using fluoroscopy. This technique requires transportation of the patients to the angio suite or the operating room, which can cause complications and

There were no relevant financial relationships or any sources of support in the form of grants, equipment, or drugs.

* Corresponding author. Tel./fax: +1- 636-527-4039.
E-mail address: aprit@aol.com

Manuscript received March 5, 2015; revised manuscript August 7, 2015

0002-9610/$ - see front matter © 2015 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.amjsurg.2015.08.017

can add additional expenses.[10–14] There is an additional risk of contrast-induced nephropathy.[15] Other methods of IVCF placement have been tried using computed tomography (CT) fluoroscopy,[16,17] transabdominal ultrasound,[18,19] and intravascular ultrasound (IVUS),[20–23] but all these techniques have their limitations.

In trauma and critically-ill patients, a contrast-enhanced CT scan of the abdomen and pelvis is commonly performed for various clinical indications. It was observed that these CT scans provide sufficient information on the iliac veins, IVC, and renal veins so that an IVCF can be placed successfully without any additional imaging during the filter deployment. After a review of anatomy, it was found that the IVC is formed as a confluence of the right and left common iliac veins on the right side of the fifth lumbar vertebral body. The IVC then ascends along the right side of the vertebral body. The common iliac veins are the continuation of external iliac veins that originate at mid-inguinal point from femoral veins. The course of the right common iliac to the IVC is straight compared with the left common iliac vein, which is oblique before it continues as the IVC. It was also observed that the femoral/external iliac vein confluence corresponds to the femoral head/neck junction along its inferior border, and the renal veins correspond to the lumbar vertebras (L1/2) in the KUB (Fig. 1). Studies also suggest that the relationship among renal veins, IVC, and spine is static.[16,24,25]

Based on these observations, we hypothesized that an IVCF can be placed below the renal vein through the right femoral venous access by measuring the distance between the right femoral venous access point and a point in the vena cava below the renal vein (landing zone) in the KUB. Using this technique, IVCF placement will be as simple as performing a bedside femoral venous line placement and will be very cost-effective.

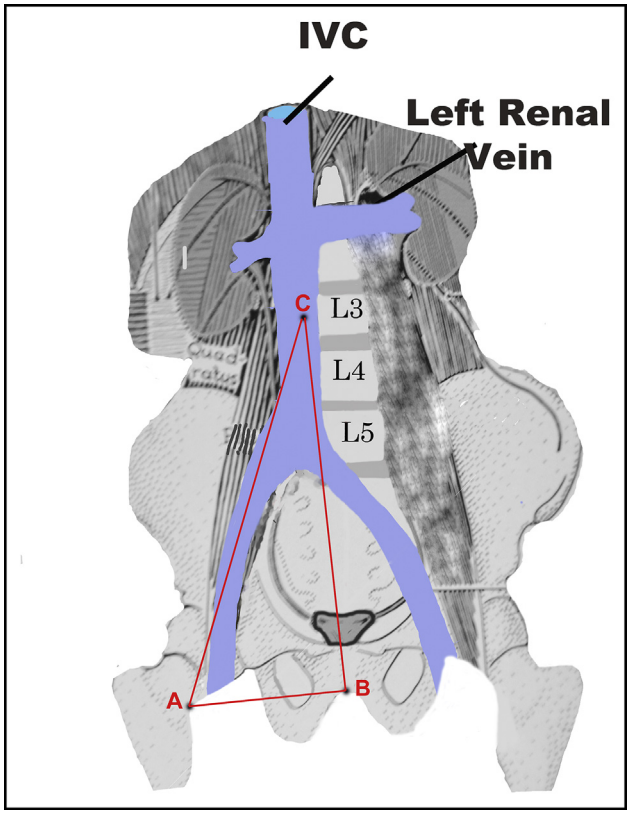

Figure 1 Anatomy of inferior vena cava and its relation to lumbar vertebra. Point (A) Junction of right femoral head and neck along the inferior border. Point (B) Midpoint of pubic symphysis along its inferior border. Point (C) At the right lateral border of lumbar vertebra below the renal vein (landing zone).

Patients and Methods

Study design

To obtain the distance between the right femoral venous entry point and a location in the IVC below the renal vein, 3 points (A, B, and C) were selected (Fig. 2).

Point A: Junction of right femoral head and neck along the inferior border (entry point in the right femoral vein).

Point B: Midpoint of pubic symphysis along its inferior border.

Point C: At the right lateral border of lumbar vertebra below the renal vein (landing zone).

After creating a triangle using the 3 points, the distance (in cm) from point A to point C was measured. This measurement was used as the landing distance of the filters in the IVC.

To prove our hypothesis, 4 retrievable (OptEase) filters were placed in the operating room based on the

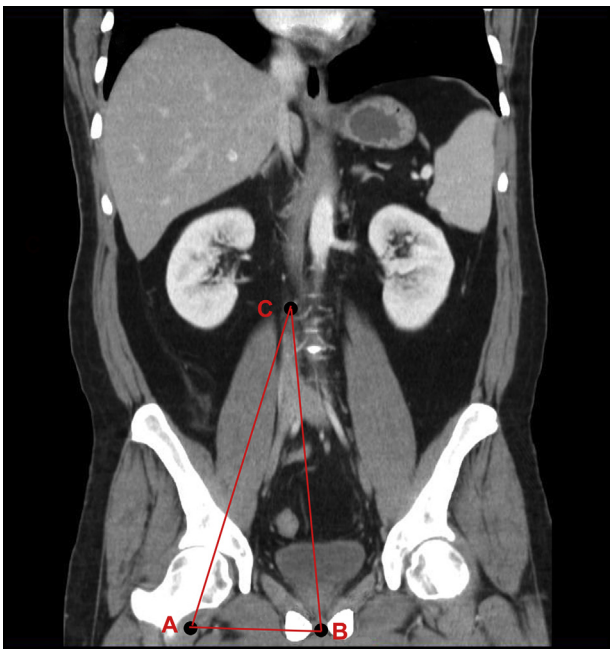

Figure 2 Three points in KUB to identify the landing zone of the inferior vena cava filters. Point (A) Junction of right femoral head and neck along the inferior border. Point (B) Midpoint of pubic symphysis along its inferior border. Point (C) At the right lateral border of lumbar vertebra below the renal vein (landing zone).