



Inferior Vena Cava (Pseudo)Thrombus: Computed Tomographic Artifact Occurring with Right Heart Failure and Tricuspid Incompetence

Aviram Nissan MD¹, Dorith Shaham MD², Naftali Kaminski MD³ and Jacob Bar-Ziv MD²

Departments of ¹Surgery and ²Radiology, Hadassah University Hospital, Jerusalem, and ³Pulmonary Institute, Sheba Medical Center, Tel-Hashomer, Israel

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Imaging artifacts are not rare, however most of them can be identified and ignored. Rarely, vascular artifacts simulate a clinical phenomenon such as a tumor or a thrombus and lead to an error in diagnosis. Artifacts simulating thrombus formation in the inferior vena cava on computed tomography have been described [1-3], and explained as poor mixing of the infra-renal blood with the renal venous flow. We evaluated three patients with right heart failure and tricuspid incompetence. In all, a "pseudothrombus" was observed in the IVC. Opacified blood refluxed from the right atrium into the yet unopacified vena cava.

All examinations were performed using an Elscint 2400 Elite scanner (Israel). Scanning time was 2 seconds and slices were 10 mm thick. Iodinated contrast (Telebrix 30 meglumine) was delivered via an arm vein at a flow rate of 2 ml/sec over 30 sec (Medrad-MCT injection system, USA). Scanning commenced at this point and an additional 60 ml of the same contrast material was then delivered at a rate of 1 ml/sec for one minute.

IVC = inferior vena cava

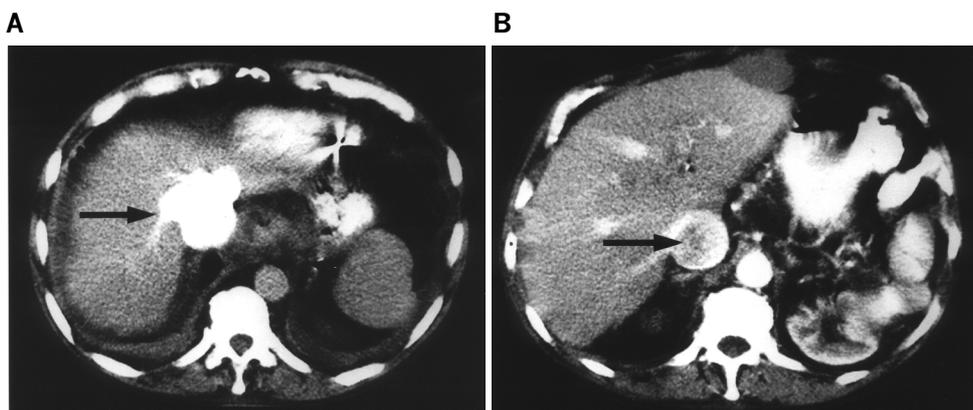


Figure 1 (Patient 1). CT of the upper abdomen; intravenous contrast material was delivered by an automatic injector. [A] Dense enhancement of dilated inferior vena cava (arrow) and hepatic veins occurring prior to aortic enhancement. [B] After 15 seconds, the branches of the hepatic arteries are already visible, while hepatic veins are still enhanced by retrograde filling. A filling defect ("pseudothrombus") is seen in the IVC (arrow) due to the flow of non-enhanced blood into the previously opacified IVC.

Case Descriptions

Patient 1

A 70-year-old man was admitted for right upper quadrant abdominal pain. His past medical history was significant for rheumatic heart disease involving the aortic, mitral and tricuspid valves. A few years earlier the patient had undergone aortic valve replacement with prosthetic valve.

Echocardiogram demonstrated moderate tricuspid and mitral incompetence with decreased right and left ventricular function. As part of the abdominal workup a CT scan with bolus injection of iodinated contrast material was performed, which demonstrated a

low density area in the opacified supra-renal IVC [Figure 1B]. Regurgitation of contrast from the right atrium was diagnosed by the appearance of contrast material in the IVC and hepatic veins before any contrast had reached the aorta [Figure 1A]. On subsequent slices, there was retrograde filling of the IVC by contrast. A filling defect in the IVC was apparent prior to visualizing the portal veins [Figure 1B]. Subsequently, when opacified blood from the venous system reached the vena cava, this "filling defect" was no longer observed.

Patient 2

A 40-year-old man was admitted com-

plaining of abdominal pain, fever and jaundice. The pain was dull and located in the upper abdomen. The patient was known to suffer from chronic active hepatitis B infection and right heart failure with tricuspid incompetence as a result of past tuberculous pericarditis treated by pericardiotomy.

Abdominal and chest CT showed thickening of the pleura, fibrosis and calcifications of the pericardium. The suprahepatic portion of the IVC was dilated and filled with contrast. There was a filling defect within the region of contrast [Figure 2]. This filling defect subsequently disappeared when contrast-enhanced blood was equally distributed in both the right atrium and the IVC.

Patient 3

A 65-year-old woman was admitted for evaluation of nephrotic syndrome and increasing peripheral edema. Echocardiography showed enlarged left ventricle with poor left and right ventricular function and severe tricuspid and mitral incompetence. CT of the abdomen showed reflux of contrast from the right atrium to the IVC. This "pseudothrombus" [Figure 3] disappeared after contrast material reached the IVC from the venous system.

Comment

We present three patients with right-sided heart failure and tricuspid incompetence who underwent abdominal CT. In all three patients a "pseudothrombus" artifact appeared immediately following the injection of intravenous contrast and disappeared on CT slices obtained later.

The normal range of inferior vena caval diameter is wide. It may be altered by changes in intra-abdominal pressure that occur in forced expiration (Valsalva maneuver) [1]. Thrombotic occlusion of the IVC may be accurately diagnosed non-invasively by computed tomography [4]. The diagnosis is based on the increased inferior vena caval diameter in the presence of a low density intraluminal filling defect that has well-defined borders. The filling



Figure 2 (Patient 2). CT of the upper abdomen showing a "pseudothrombus" in the IVC (arrow). In this case portal vein enhancement is evident (arrowhead). There is an incidental finding of a cyst in right lobe of the liver.

defect may represent a blood clot or a tumor thrombus. The diagnosis of IVC thrombosis by CT is not specific, and artifacts such as those described here can lead to a false diagnosis.

Intraluminal low density regions have been described during foot vein injection [1], a procedure that has been advocated for optimal visualization of the IVC. It has been proposed that the opacified column of blood in the IVC, mixed with large amounts of unopacified blood from the renal veins, is responsible for the "pseudothrombus" effect [1]. Another explanation suggests that due to laminar flow, the slow opacified blood from the lower extremities flows close to the vessel wall while the non-opacified renal blood flows centrally [1]. "Pseudothrombus" has also been reported with rapid arm vein contrast material infusion [2,3]. This was attributed to laminar flow of opacified renal venous blood around the less opacified infra-renal caval blood. The relatively high flow of blood to the kidneys, the extraction of water through the renal tubules, and the early arrival of contrast material to the kidneys compared to the lower extremities were suggested as factors contributing to this phenomenon [3]. It was postulated that the use of a power injector for the delivery of contrast material may predispose to the pseudothrombus artifact [3].

Abdominal pain is a frequent complaint among patients with right heart

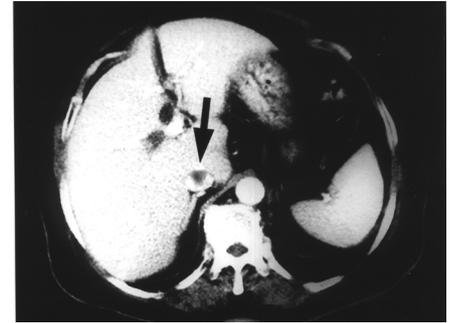


Figure 3 (Patient 3). CT of the upper abdomen showing "pseudothrombus" in the hepatic portion of the IVC (arrow).

failure and tricuspid incompetence and may be attributed to hepatic congestion. Morphologic changes in hepatic congestion seen on CT include enlargement of the IVC and hepatic veins, which is particularly prominent with tricuspid regurgitation where right ventricular pressure forces blood flow in a retrograde fashion to the IVC and hepatic veins. Following intravenous contrast administration, the liver enhances in a heterogeneous patchy (mosaic) pattern during the dynamic phase and becomes homogenous with delayed imaging [5,6]. In such situations, the appearance of the liver should not be mistaken for a diffuse infiltrative disorder or other vascular disorder.

The combination of abdominal pain and the "pseudothrombus artifact" may lead to a false diagnosis of IVC thrombosis. To our knowledge, this is the first report of the association between the "pseudothrombus" artifact with right heart failure and tricuspid incompetence.

Several characteristics may differentiate the "pseudothrombus" from true IVC thrombosis: The "pseudothrombus" has non-sharp borders and is not well defined as a true intracaval thrombus [2], and repeated delayed scans and or dynamic scanning through the area in question help to exclude true inferior vena caval thrombosis [1,2].

The vena caval "pseudothrombus" is a rare phenomenon and may be asso-

ciated with regurgitation of opacified blood from the heart. We show that it may occur in patients with right-sided heart failure and tricuspid incompetence. Some of the patients described in earlier reports of "pseudothrombus" might have had right-sided heart failure or tricuspid incompetence. We conclude that the differential diagnosis of "pseudothrombus" should be considered when performing abdominal CT in patients with right-sided heart failure or tricuspid incompetence.

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Correspondence: Dr. A. Nissan, Dept. of Surgery, Hadassah University Hospital, P.O.Box 23045, Mount Scopus, Jerusalem 91240, Israel. Phone: (972-2) 584-4550, Fax: (972-2) 532-3005, email: anissan@netvision.net.il

Computed Tomography Diagnosis of a Perforating Malpositioned Central Venous Catheter

Osnat Konen MD, Rivka Zissin MD and Myra Shapiro-Feinberg MD

Department of Radiology, Meir General Hospital, Sapir Medical Center, Kfar Saba, Israel

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Complications of central venous catheterization have been widely described and include pneumothorax, vessel laceration, air embolus, malposition, catheter fragmentation and embolization, infection, venous occlusion and perforation of the great vessels. The latter is an uncommon complication but is often fatal. We report a case of perforating malpositioned central venous catheter that was diagnosed incidentally while performing an abdominal computed tomography scan.

Case Description

A 66-year-old mentally retarded male presented with fatigue, weakness and general deterioration of 2 weeks. No medical history was available. Physical evaluation revealed hypotension, cyanosis, unuria and leukocytosis. Chest X-ray showed bilateral pleural effusion with pulmonary edema. He was admitted with the presumed diagnosis of

CVC = central venous catheter

septic shock and failure. A CVC was inserted via the left jugular vein for monitoring purposes.

A chest X-ray obtained after the catheter insertion demonstrated the catheter overlying the presumed site of the superior vena cava. There was no change in the amount of pleural fluid or the width of the mediastinum between this film and that performed at admission. The following day the patient became irritable with diffuse abdominal tenderness. A subsequent abdomi-



Figure 1. Axial CT scan obtained at mid-thorax level shows extravasation of the injected contrast media surrounding the CVC tip (arrow) within the mediastinum. Note bilateral pleural effusion (P).

intravenous injection of contrast media via the CVC. The CT displayed free intra-abdominal air and contrast

stained peritoneal fluid compatible with hollow viscous perforation; in addition, bilateral pleural fluid and mediastinal extrapleural extravasation of contrast media were found without evidence of pericardial effusion [Figure 1]. A longitudinal CT scan obtained immediately after the CT scan showed the dense contrast media accumulating in the extravascular mediastinal space, an increase in mediastinal width, and an upward angulation of the CVC tip in comparison to the previous chest X-ray.

An explorative laparotomy was then performed, which disclosed a perforated duodenal ulcer. The patient expired several hours later.

Comment

With the increasing use of CVC the frequency of misplaced catheters and resultant complications has also increased. Complications of CVC placement include pneumothorax, vessel laceration, air embolus, malposition, catheter fragmentation, infection, venous occlusion and perforation [1,2]. Although perforation of a great vessel is an uncommon complication (less than 1%), it is often fatal. Perforation usually results in hydro/hemomediastinum with or without hydro/hemothor-

ax. Nevertheless, the catheter may erode through the mediastinal pleura to cause isolated right hemo/hydrothorax [3,4]. Less frequently, when eroding the vessel wall below the pericardial reflection it may cause cardiac tamponade. Routine chest X-ray is usually indicated following CVC insertion unless imaging guidance and an interventional radiological technique are used [5]. Correct positioning of the CVC tip into the distal brachiocephalic vein or the proximal superior vena cava is essential to minimize complications. The catheter's tip should appear parallel to the vessel wall [2]. Rarely, injection of iodinated contrast material is needed to define the ectopic location of the catheter tip. If incorrectly placed the catheter may cause venous obstruction and migration to the inferior vena cava, pulmonary artery or hepatic vein, and could lead to cardiac arrhythmias and perforation of the cardiac wall or great vessel [6]. The perforation may present immediately after insertion due to impingement of the catheter tip against the venous wall, or it could be delayed due to catheter migration and venous wall erosion.

The most common and alarming finding suggestive of perforation of

the great vessels is a widening of the mediastinum as noted on sequential chest X-rays. However, this sign may be difficult to recognize in acutely ill patients with supine X-rays. In our patient, a great vessel perforation was incidentally found on a CT scan performed for the evaluation of acute abdomen. No prior suspicious clinical or imaging findings were recognized even retrospectively.

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Capsule

