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Case Report

Management of malignant inferior vena cava syndrome (IVCS) by endovascular bridging stent placement☆

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ABSTRACT

A 73-year-old male patient was admitted to the emergency department with dyspnea and severe edema in the lower extremities. The patient had been diagnosed with extensive small-cell lung cancer 15 months previously. Contrast-enhanced CT revealed suprahepatic compression of the inferior vena cava (IVC) at the level of its entry into the right atrium, caused by a space-occupying, infiltrating right lung lesion. Inferior vena cava syndrome (IVCS) occurs after obstruction of venous flow through the IVC. Trunk and lower limb edema are the most common manifestations of this syndrome, whereas cardiac function may be compromised in more severe cases. Given the patient's performance status, disease stage, and symptom acuity, endovascular stenting of the IVC was preferred over surgery or radiotherapy. The superior vena cava (SVC)-to-IVC bridging stent approach was employed to address the severe mass effect and location of the IVC stenosis at its junction with the right atrium. Three uncovered self-expandable stents were deployed in tandem from the SVC to the IVC. Overlap between stents minimized the risk of collapse within the right atrium, possibly leading to cardiac conduction disorders or even perforation of the heart wall. The patient experienced alleviation of IVCS symptoms over the next 48 h but unfortunately passed away 8 days later from his primary disease. Although primarily palliative in oncologic cases, SVC-to-IVC stenting can offer rapid and safe relief of symptoms in patients with advanced oncologic disease by restoring venous return to the heart.

☆ Competing Interests: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Introduction

Restoration of venous drainage after venous thrombosis, tumor infiltration, or venous compression is a common clinical challenge in oncology. Malignant compression of the inferior vena cava (IVC) is less often encountered and reported than that of the superior vena cava (SVC). Inferior vena cava syndrome (IVCS) is caused by compression, infiltration, stenosis, or thrombosis of the IVC, whereas rarely, it may result from IVC agenesis or Budd–Chiari syndrome [1,2]. Venous flow obstruction in the lower body leads to ascites, lower extremity peripheral edema, anasarca, and genital swelling [1]. In severe IVC stenosis, the cardiac preload and output may also be affected, and hemodynamic instability may arise [1]. The degree of IVC obstruction does not always correlate with the severity of symptoms, and patients may be asymptomatic despite substantial stenosis [1,2]. In general, the appearance of symptoms depends on the acuity and extent of the blockage and the development of venous collateral pathways.

The underlying etiology, patient clinical status, and therapeutic options available at the institution determine the management and treatment of IVCS. The goal of IVC compression is removal of the etiology. This can be achieved by surgery, radiotherapy, chemotherapy, or endovascular stenting. Endovascular techniques constitute a minimally invasive method that enables rapid relief of symptoms, especially in patients with poor performance status and an extensive disease burden.

We report the case of a 73-year-old patient with advanced lung cancer who presented to the emergency department with dyspnea and trunk and lower extremity edema due to severe IVC stenosis. IVC decompression was achieved using an SVC-to-IVC bridging stent approach.

Case study

A 73-year-old male patient with extensive-stage small-cell lung cancer (SCLC) presented to the emergency department with dyspnea, abdominal distension, and lower-extremity edema. The patient had been diagnosed with SCLC 15 months previously and had received 6 cycles of carboplatin/etoposide chemotherapy, followed by thoracic radiotherapy and prophylactic cranial irradiation. No other family or medical history was reported. The patient had lost 20 kg of body weight within 12 months. Performance status was recorded (4) on the Eastern Cooperative Oncology Group scale on the day of admission (i.e., disabled, unable to carry out any self-care, totally confined to bed or chair). Vital signs were recorded: systolic/diastolic blood pressure 100/70 mmHg, heart rate 90 bpm, oxygen saturation 89%, body temperature 36,9°C/98°F.

Fig. 1 – Contrast-enhanced CT reveals a large tumor involving the right lower and middle lung lobe measured (17,6 x 19,3 x 18,6) mm (maximal axial x coronal x sagittal dimension), which causes significant compression of the IVC (yellow arrows) mainly at the level of its entry into the right heart atrium. (A) axial, (B) coronal, and (C) sagittal view.

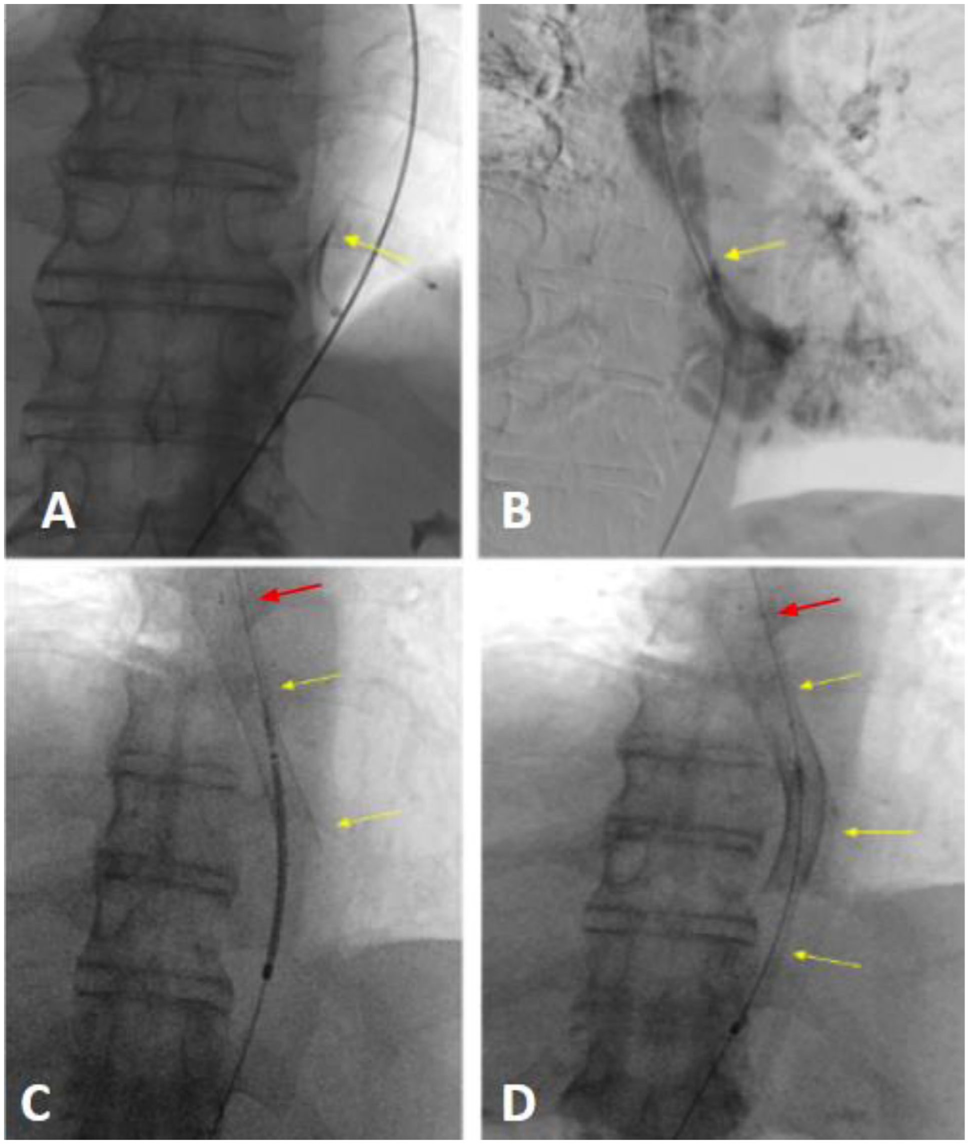

Fig. 2 – (A and B) Digital venography illustrating significant stenosis of the suprahepatic inferior vena cava (IVC) due to compression. (C and D) Three self-expanding stents (yellow arrows) were positioned in tandem from the superior vena cava (SVC) (red arrow shows the most cephalic part of the stents) to the IVC to restore venous patency.

Results from laboratory tests were as follows: hemoglobin 12,6 g/dl (normal range 14-18 g/dl), platelets 260 $\times$ $10^3/\mu l$ (150-450 $\times$ $10^3/\mu l$), alkaline phosphatase 94 U/L (26-112 U/L), alanine aminotransferase 40 U/L (5-35 U/L), aspartate aminotransferase 34 U/L ($<$40 U/L), total bilirubin 0,88 mg/dL (0,2-1,2 mg/dl), and INR 1,3.

Contrast-enhanced chest and abdomen computed tomography showed a mostly solid with large necrotic areas and right lower and middle lung heterogeneously enhancing mass measuring 17,6 $\times$ 19,3 $\times$ 18,6 mm (maximal axial $\times$ coronal $\times$ sagittal dimensions) exerting mass effect on the mediastinum (Fig. 1). Multiple enlarged mediastinal lymph nodes, infiltration of the visceral pleura and right hemidiaphragm, ascites, and peritoneal metastases were other salient findings underlining disease progression. Significant compression and stenosis of the suprahepatic segment of the IVC prior to insertion into the right atrium (RA) was also noted. The RA and hepatic veins were normal (Fig. 1).

Given the patient's extensive malignancy, clinical status, and severity of symptoms, endovascular intervention was deemed the most appropriate. Written informed consent for the procedure was obtained from all patients. Under local anesthesia, a 5F sheath was inserted into the right basilic vein and a 10F sheath into the right common femoral vein. Venography showed a significant compression of the suprahepatic IVC.

The IVC stenosis was passed using a 0,035-inch hydrophilic guidewire and a multipurpose catheter. Initially, mechanical thrombectomy was performed to exclude possible thrombosis; however, no thrombotic material was extracted. After placing a stiffer exchange guidewire with its distal tip positioned in the right subclavian vein, 3 uncovered self-

Fig. 3 – The final venography revealed adequate flow through the bridging stents (yellow arrows).

expanding nitinol sinus-XL stents (OptiMed, Ettlingen, Germany) were deployed in tandem from the SVC to the IVC with an overlap between the stents (Fig. 2). Using venography measurements, stents measuring 18 × 80 mm, 18 × 60 mm, and 16 × 80 mm were placed in a cephalic-to-caudal orientation. The final venography revealed adequate flow through the vena cava and bridging stents (Fig. 3).

The patient's IVCS symptoms, mainly trunk and lower limb edema, were significantly alleviated within 48 h. Low-molecular-weight heparin was administered. The patient continued his hospital stay after the stenting and died 8 days later from his primary disease.

Discussion

Inferior vena cava compression may be asymptomatic or cause alarming symptoms and threaten cardiac function in more severe cases. Conventional treatments such as surgery and radiotherapy are not always options for patients with a significant tumor burden, and when possible, they do not offer rapid and permanent symptom relief. Stenting for malignant IVCS is indicated in patients with severe or persistent symptoms after radio- or chemotherapy, or in cases where radio- or chemotherapy is contraindicated [1]. SVC-to-IVC stenting is usually a clinically palliative decision, but is technically demanding. Stabilization of stents in the suprahepatic IVC can be achieved by placing them in tandem from the SVC through the right atrium and anchoring them in the noncompressed IVC segment [3,4].

The ideal stent for SVC-to-IVC bridging should be long and stiff, with a large anchoring and overlapping zone [5]. The goal is to achieve stability of the bridging stent, which is threatened by RA movement according to the cardiac cycle. A normal IVC diameter in the anchoring zone is another challenge because it fluctuates during respiration. Therefore, the stent diameter should be measured during the Valsalva maneuver and > 20% oversizing is necessary [5]. Covered stents cannot be used since blood flow into the RA must be maintained.

Stent collapse inside the RA may result in disturbance of cardiac conduction, valvular damage, endocarditis, and even heart wall perforation [1,6]. The more stents deployed, the higher the risk of vascular injury and rupture. Stent thrombosis and pulmonary embolism are also potential threats of IVC stenting [1]. Increased venous return after recanalization can also lead to pulmonary edema [7]. Cost and stent availability are other limitations that must also be considered. In addition, the short life expectancy of patients does not allow for long-term reporting of SVC-to-IVC bridging side effects. The death of patients at 27 [3], 30 [4], and 60 and 90 [5] days postbridging has been reported for clinical reasons other than the stenting procedure itself. Our patient died 8 days after the stenting procedure because of the primary disease, without any IVCS-related symptoms. The time of death after the procedure varies greatly and relies on factors other than stenting, such as tumor burden, age, and comorbidities.

In a retrospective study of 57 patients with malignant obstruction of the IVC, stent placement achieved 100% vein patency and rapid relief of IVCS symptoms within 7 days. [8]. In a meta-analysis of 33 studies with 1575 patients, thrombosis, Budd-Chiari syndrome, and malignant IVCS were the most common indications for IVC stenting, with a technical success rate of 78%-100% [9]. Despite the publication of guidelines for iliocaval stenting by the Cardiovascular and Interventional Radiological Society of Europe (CIRSE), no standardized procedure or follow-up protocol has been proposed for the SVC-to-IVC bridging technique [10]. Indications, stent types, and outcome reporting vary among institutions. The long-term behavior of these stents is not well established, particularly under constant respiratory and cardiac movements. Although anticoagulation therapy is usually suggested after the procedure, no consensus has been reached regarding duration or type. Large randomized studies are necessary to assess the efficacy and benefits of this procedure. Unfortunately, long-term follow-ups are hindered by the low life expectancy of patients undergoing treatment.

Patient consent

Written, informed consent for publication of this case was obtained from the patient.

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