

# Treatment of Superior Vena Cava (SVC) Syndrome and Inferior Vena Cava (IVC) Thrombosis in a Patient with Colorectal Cancer: Combination of SVC Stenting and IVC Filter Placement to Palliate Symptoms and Pave the Way for Port Implantation

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**Abstract** Thrombosis of the inferior vena cava is a life-threatening complication in cancer patients leading to pulmonary embolism. These patients can also be affected by superior vena cava syndrome causing dyspnea followed by trunk or extremity swelling. We report the case of a 61-year-old female suffering from an extended colorectal tumor who became affected by both of the mentioned complications. Due to thrombus formation within the right vena jugularis interna, thrombosis of the inferior vena cava, and superior vena cava syndrome, a combined interventional procedure via a left jugular access with stenting of the superior vena cava and filter placement into the inferior vena cava was performed. As a consequence, relief of the patient's symptoms, prevention of pulmonary embolism, and paving of the way for further venous chemotherapy were achieved.

**Keywords** Interventional procedures · Inferior vena cava filter · Pulmonary embolism · Superior vena cava syndrome · Vena cava stent · Venous thrombosis

## Introduction

In industrial nations like the United States, colorectal cancer is the second leading cause of death from cancer [1]. Such a systemic disease may lead to a 4.1-fold elevated risk of a venous thrombosis [2]. The chance of a venous thromboembolism (VTE) is specifically high in patients

treated with a combination of fluorouracil and leucovorin calcium because of colorectal cancer (15% of patients were affected) [3]. The 1-year survival rate of cancer patients afflicted by such an event is 12%, versus 36% in patients without embolism [4]. Pathogenetic mechanisms of hypercoagulability are the production of procoagulants and the activation of endogenous prothrombotic factors by the tumor itself [5, 6].

Besides liver and lung metastasis, colorectal cancer can also affect the adrenal gland, which constitutes only 13.5% of all adrenal metastasis of primary tumors [7]. More common in renal cell carcinoma or adrenocortical carcinoma, an adrenal metastasis of a colorectal cancer can also invade the inferior vena cava (IVC), causing a dangerous situation requiring intervention, like a vena cava filter, to prevent pulmonary embolism [8, 9].

Another rare complication of colorectal cancer is superior vena cava syndrome (SVCS), causing obstruction of the superior vena cava (SVC) [10]. Owing to its thin wall and the low intravascular pressure, the SVC has only a low resistance to an extrinsic compression, and thrombus formation is easily possible. This may result in congestion and edema of the face and upper thorax, as well as symptoms like dyspnea, dysphagia, cognitive dysfunction, and headache. Therapeutical options for patients with SVCS having already received chemotherapy and radiation therapy are limited. Venous stenting is usually helpful in such palliative situations, where life quality is paramount, due to the simplicity of the procedure and rapid relief of symptoms [11].

This rare case therefore highlights the subsequent management of SVCS and IVC thrombosis with stent placement and filter insertion in a patient with metastatic rectal cancer to relieve symptoms, prevent pulmonary embolism, and pave the way for port implantation.

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## Case Report

Our institutional review board does not require approval for publication of retrospective case reports. A 61-year-old female with a history of metastatic rectal cancer was referred to our hospital for surgical port implantation. In the distant past, primary staging had yielded malignant pulmonary and mediastinal spread, and the patient preoperatively underwent two cycles of chemotherapy combined with external-beam radiotherapy (45 Gy) to the rectum. Four months after primary diagnosis, a complete mesorectal excision and low anterior resection with colorectal anastomosis was carried out by our visceral surgeons. The pathological analysis revealed a pT3, pN1, M1, G2 stadium of the tumor. Three months after surgery, suspicion of metastases of the liver was confirmed by magnetic resonance imaging of the abdomen showing two lesions in segments V/VI with a diameter of 5.4 cm and VII/VIII with diameter of 1.7 cm. As a consequence, hemihepatectomy of the right lobe was scheduled 1 day later.

The situation seemed to be stable, when a PET-CT scan exposed a progression of the pulmonary and mediastinal lesions 21 months later. These findings led to an expansive resection of the right lung by our thoracic surgeons (upper lobe resection, two-times atypical resection of the middle lobe, two-times atypical resection of the lower lobe, mediastinal retrocaval lymphadenectomy), with an R0 situation of all metastases, except for the retrocaval manifestation, with an R1 situation. One day postoperatively, CT showed a thrombosis of the right internal jugular vein and the right brachiocephalic vein. Treatment of venous thrombosis was initiated with oral anticoagulation therapy. Over the next 3 months, increasing symptoms of SVCS with swollen head and arm veins, headache, dyspnea, and livid face occurred. Another CT examination was performed that further exhibited thrombosis of the right internal jugular vein and the right brachiocephalic vein, but also recurrent mediastinal tumor spread and new onset of an inhomogeneous hypodense metastatic lesion of the right adrenal gland with an extent of 7.0 × 7.2 cm. As a consequence, the Department of Oncology was consulted and recommended palliative chemotherapy according to the FOLFOX scheme. On the grounds of the oral anticoagulation and thrombosis, no port could be installed, and the first cycle of chemotherapy had to be arranged via a peripheral access.

One month later, due to persisting symptoms and the fact that an efficient port would be a major part of the continuing therapy, the patient was referred to our interventional radiology department for SVC stent implantation. The major intention of this approach was to relieve symptoms and contemporaneously pave the way for port implantation. At this point in time oral anticoagulation had been stopped. We initiated a follow-up CT to evaluate the actual situation before stent implantation. The scan showed that the metastasis



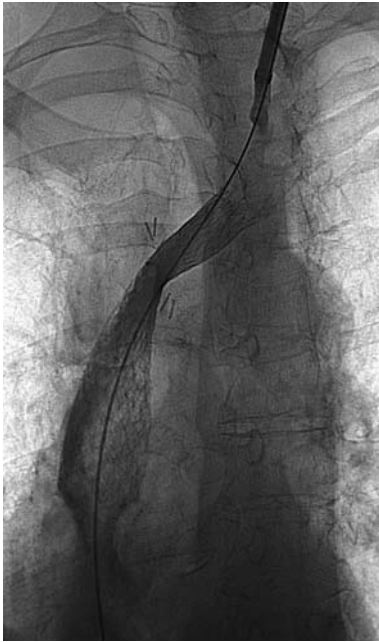
**Fig. 1** Contrast-enhanced CT scan shows metastasis of the adrenal gland with tumor invasion and partial thrombosis of the IVC

of the adrenal gland now reached 7.2 × 8.4 cm, with tumor invasion into the right suprarenal vein and renal vein, and with luminal compression of the IVC to 50% with partial concomitant thrombosis (Fig. 1). Moreover, the mediastinal tumor mass was now compressing the confluence of the right brachiocephalic vein and the SVC. Due to the overall constellation, thrombosis of the right internal jugular vein and partial thrombosis of the IVC, the decision was made to choose the left jugular vein access and to combine SVC stent implantation with suprarenal IVC filter insertion.

Following informed consent and local anesthesia, left internal jugular vein puncture was performed under ultrasound guidance, and a 13-Fr sheath was inserted. Bicubital mediastinal venogram confirmed compression of the confluence of the right brachiocephalic vein and of the SVC by a tumorous mass (Fig. 2). A 5000-unit bolus of heparin was



**Fig. 2** Bicubital venogram demonstrates a tumorous mass lesion compressing the confluence of the right brachiocephalic vein and the SVC



**Fig. 3** Bicubital venogram after unilateral stent placement within the SVC and left brachiocephalic vein exhibits good restoration of flow

administered. After the length of the affected venous confluence had been quantified with a calibrated pigtail catheter, unilateral stent placement was undertaken. Including the left brachiocephalic vein and SVC, a self-expanding  $22 \times 90$ -mm sinus-Aorta-Stent (Optimed; Ettlingen, Germany) was placed just above the right atrial level, with a good outflow of contrast medium (Fig. 3). In continuation, a femoral venogram was performed and exhibited tumor encasement of the IVC with partial thrombosis at the level of the right suprarenal vein. A retrievable vena cava filter (OPTEASE; Cordis, Roden, The Netherlands) was then successfully inserted in a suprarenal position using the left jugular access (Fig. 4). A femoral approach for inferior vena caval infiltration was avoided, so as not to trigger pulmonary embolism. At the end of the intervention, full-scale heparinization (10 units/kg body weight per 24 h) was initiated. Surgical port implantation was performed 1 month later, and chemotherapy was recommenced. The patient had excellent relief from her symptoms of SVCS, did not experience pulmonary embolism during a follow-up of 6 months, and is in a well general condition to date.

## Discussion

Armand Trousseau was among the first authors who described the relationship between cancer and VTE [12]. Matter of factly, his theories proved to be correct, when he diagnosed himself with stomach cancer because of a



**Fig. 4** Femoral venogram depicts successful suprarenal IVC filter insertion just above the thrombus formation

phlebitis on his left upper limb. In his honor, the coincidence of cancer and VTE is called Trousseau syndrome, belonging in the paraneoplastic sphere.

Jaffer et al. [2] calculated an elevated risk of thrombosis in cancer patients, underlining the topicality of this issue. Cancer patients with VTE further have an increased probability of death compared to patients without a thromboembolic event. This was proved by Sørensen et al. [4] in an age-, gender-, and diagnosis-matched study. The 1-year survival rate among cancer patients without VTE was 36%, versus 12% in patients with a thrombosis.

The development of thrombi can also be potentiated by risk factors concerning treatment of the cancer [13, 14]. There are specific chemotherapeutic agents increasing the incidence of thrombotic events, for example, tamoxifen in the therapy of breast cancer or platinum-based therapies, 5-fluorouracil, mitomycin, growth factors, and thalidomide. Additionally, surgery, radiotherapy, and immobility may initiate platelet aggregation [15].

Reviewing the literature for rectal, Rickles et al. [16] listed the most frequently associated tumors with venous thrombosis and revealed a 15.2% frequency for colon cancer. In addition, Levitan et al. [17] showed that even 62 of 10,000 patients with rectal cancer develop a deep venous thrombosis or pulmonary embolism. Specifically, rectal cancer patients treated with a combination of fluorouracil and leucovorin calcium, as in our case, because of colorectal have a high risk (15%) for developing a VTE [3].

Different pathogenetic mechanisms have been described to better understand the appearance of the hypercoagulable state [18–20]. There are alterations in coagulation and anticoagulant proteins and endothelial cells due to the cytotoxic agents. In addition, the tumor itself can produce

procoagulants and activate endogenous prothrombotic factors [5, 6].

Venous thromboembolic events include superficial and deep venous thrombosis, pulmonary embolism, and catheter-associated thrombosis [15]. While deep vein thrombosis is the most common type of thromboembolic event, SVCS is a rare complication.

A mediastinal invasion by bronchogenic carcinoma is the most common cause of SVCS, accounting for 70%–80% of all cases [10]. In our case, secondary spread of a rectal tumor into the retrocaval, mediastinal lymph nodes caused the syndrome, with congestion, edema of the face and upper thorax, dyspnea, and dysphagia.

Different strategies for the treatment of SVCS exist [21–23]. Many authors postulate chemotherapy and radiotherapy as the standard treatment for SVCS in association with malignant disease. Rodrigues et al. [21] treated SVCS with three weekly high-dose fractions of 8 Gy and achieved a partial response in 96% of all patients, and a complete response in 56%. It must be considered that radiotherapy may have side effects like fever, nausea, vomiting, and mucositis, so that the patient loses further quality of life [10].

Charnsangavej et al. [22] were the first to describe SVC stenting as a further option. Since then, it has become a standard treatment for this condition, because it provides rapid relief of symptoms and the relief of SVCS in 80%–95% of patients [23]. However, in cases of SVCS caused by small cell carcinomas and lymphomas, chemotherapy is recommended as the first-line treatment [21,23].

Concomitant treatment with anticoagulants after SVC stenting may generally reduce the risk of deep venous thrombosis in cancer patients [11, 22, 23]; moreover, anticoagulation may induce delays of neoendothelial proliferation. However, to date, a clear consensus concerning the application and dosage of anticoagulant agents in combination with SVC stent implantation does not exist.

Parallel to stents, IVC filters have developed increasingly over the past two decades. Since their introduction in 1973, these filters have proven to be safe and effective in the prevention of life-threatening pulmonary emboli [24]. Jarrett et al. [25] have shown that even advanced-stage cancer patients may benefit from IVC filters. In a study by Wallace et al. [24] the probability of survival at 30, 90, and 365 days in patients with gastrointestinal cancer was 79%, 54%, and 29%, respectively.

However, with regard to the clinical literature, the utility of IVC filters is not universally accepted and results are somewhat conflicting [26, 27]. In this context, a prospective, controlled clinical trial by Decousus et al. [27] reported that inferior vena caval infiltration was useful in preventing pulmonary embolism when combined with anticoagulation. Nevertheless, an improvement in overall

mortality in patients with such a combined therapy did not vary significantly from these patients with anticoagulation alone. Most importantly, in patients with inferior vena caval infiltration and anticoagulation a twofold increase in recurrent deep venous thrombosis was observed in comparison to patients with anticoagulation alone.

Some authors have already reported that practice patterns concerning IVC infiltration were different and that many indications for IVC filter insertion were a matter of opinion [26–28]. With respect to Trousseau's syndrome, therapy with heparin anticoagulation alone is reported to be effective and the therapy of choice [28]. Since this syndrome is a hypercoagulable state, inferior vena caval infiltration is said to be inadequate. In our case, it remains speculative if IVC thrombosis was attributable to tumor invasion or to systemic hypercoagulability. Even though our patient had formerly experienced right jugular vein thrombosis, this complication might have been interpreted as postsurgical syndrome. Therefore, the combination of IVC filtration and anticoagulation after SVC stent implantation seemed justified for us.

In conclusion, with regard to the clinical scenario described herein, we see in SVC stenting and IVC filter implantation combined with heparin anticoagulation an efficient and safe approach to the therapy of SVCS and IVC thrombosis to pave the way for further chemotherapeutic treatment and to guarantee palliation in progressive rectal cancer. Interventional radiologists as well as clinicians should be aware of such an extraordinary course of malignant disease in order to provide effective management.

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