



MANAGEMENT OF SUPERIOR VENA CAVA SYNDROME IN LUNG CANCER PATIENTS BY STENT ASSISTED ANGIOPLASTY: A RETROSPECTIVE SINGLE CENTER STUDY

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Abstract

Background: Superior vena cava (SVC) syndrome refers to the constellation of clinical manifestations caused by obstruction of blood flow through SVC. Malignant obstruction can be caused by direct invasion of tumor into the SVC, or by external compression of the SVC by an adjacent pathologic process involving the right lung, lymph nodes, and other mediastinal structures, leading to stagnation of flow and thrombotic obstruction, which can be managed by Stent assisted SVC angioplasty

Aim of the study: This study aims to retrospectively evaluate the safety and effectiveness of the Stent assisted SVC angioplasty in the treatment of SVC syndrome caused by lung cancer as a palliative procedure.

Materials and Methods: Clinical and radiological records of all patients presenting with SVC syndrome and symptoms of facial swelling & dyspnea who underwent stent assisted angioplasty at our center between November 2022 to August 2024 were analyzed. 12 such cases were identified and all details were noted and assessed.

CT angiography or DSA (digital subtraction angiography) was done to calculate the length of involvement and diameter of the landing zone. When necessary, suction thrombectomies were executed prior to stent deployment. Stent assisted SVC angioplasty was performed via either internal jugular vein (IJV) in SVC from distal to proximal landing zone. Post procedure DSA in two orthogonal planes was obtained to confirm the patency of the stent.

Conclusion: Endovascular stenting is very effective in the treatment of SVC syndrome by establishment of patent blood flow and amelioration of the clinical manifestations. Relief of symptoms (facial swelling and dyspnea) occurred within 24 hours after the SVC stenting in all patients.

Key words: Superior vena cava Syndrome, facial swelling, dyspnea, Stent assisted angioplasty

Introduction:

Superior vena cava (SVC) syndrome encompasses a constellation of symptoms and signs resulting from superior vena cava obstruction. SVC obstruction may be caused by invasion of SVC by the tumor directly, or SVC compression by other pathologic processes nearby involving lymph nodes or right lung which subsequently affect the blood flow and hence causing thrombosis [1].

The constellation of clinical manifestations of superior vena cava syndrome can include facial swelling, neck distension and enlarged veins of the upper chest. Progression of symptoms without treatment can lead to encephalopathy and finally death [2].

Since its initial introduction by Charnsangavej et al. in 1986, the utilization of Stent assisted SVC angioplasty has seen a growing acceptance in addressing SVCO [3]. This is attributed to its swift and efficient alleviation of symptoms, surpassing the efficacy of conventional treatments such as radiotherapy and chemotherapy. A systematic review conducted by Rowell and Gleeson determined that stenting emerges as the most efficient and rapid approach for alleviating SVCO symptoms. The findings indicate an impressive overall symptomatic relief rate of 95%, coupled with a modest 11% recurrence rate of symptoms in patients [4].

Over the last two decades, the adoption of primary stenting as the initial treatment approach has become widely accepted and is now considered standard practice [5, 6, 7]. However, the available evidence is sparse, non-homogenous, and there is a lack of thorough exploration into the impact of procedural characteristics, such as stent type or the use of anticoagulation.

This study aims to retrospectively evaluate the effectiveness of the stent placement in the treatment of SVC syndrome caused by lung cancer as a palliative procedure.

Methods:

Required institutional ethical approval was obtained from the institution and all ethical protocols were followed. This study was conducted in accordance with the Helsinki Declaration. We reviewed the retrospective data regarding patients with SVC syndrome caused by lung cancer, who had been symptomatic with dyspnea and facial swelling, and were treated at our center with endovascular stenting between November 2022 and August 2024. A total of 12 patients were treated.

Before undergoing angioplasty, the patients would have undergone computed tomography angiography or DSA (digital subtraction angiography) to estimate the dimensions of the involved segment of the SVC. In the presence of a significant thrombotic burden, the patients might have additionally undergone pre-operative anticoagulation with low molecular weight heparin with or without suction thrombectomies so as to reduce the thrombotic burden. Pre stenting serial balloon angioplasty was done in all cases by incremental balloon sizes, starting from 5 mm and going up to 12 mm, in terms of diameter and length so as to cover the whole length of stenosis and additional 1 cm in both landing zone proximally & distally. Thus, the SVC would have been pre-dilated before deployment. The stent(s) was deployed from the internal jugular vein (IJV) route in SVC from distal to proximal landing zone. Post procedure, DSA in two orthogonal planes was obtained to confirm the patency of the stent. In the post-procedure period, the patient was prescribed Aspirin 150 mg daily. Follow-up records were reviewed at 24 hours post procedure and at 3 and 6 months to assess the symptoms of facial edema, dyspnea or development of any new symptoms.

The primary efficacy outcomes of this study will include the relief of SVC syndrome symptoms, such as facial swelling and dyspnea, within 24 hours following endovascular stenting, serving as the primary indicator of short-term treatment success. Long-term efficacy will be assessed by evaluating the persistence of symptom-free status at 3- and 6-months during follow-up. Additionally, the achievement of technical success in the stenting procedure will be considered as an important measure of overall treatment efficacy.

In this study, safety outcomes will be assessed by evaluating the rate of procedural complications and procedure-related mortality over the course of the 6-month postoperative period.

Results:

Tables 1 and 2 provides a comprehensive overview of the demographic and clinical characteristics of patients diagnosed with lung cancer-related superior vena cava (SVC) syndrome. This study highlights several key findings regarding the age distribution, gender predominance, histological types, cancer staging, symptoms, and treatment approaches in these patients.

Demographics:

- Age Distribution: Approximately 67% of the patients were aged 60 years or older, indicating a higher prevalence of SVC syndrome among the elderly population.
- Gender: A significant majority of the patients were male, comprising 92% of the total patient cohort.

Clinical Characteristics:

- Histological subtypes: The two predominant histological subtypes identified were squamous cell carcinoma (67%) and adenocarcinoma (17%).
- Cancer Stage: All patients were diagnosed with stage IV lung cancer (Figure 1). The SVC syndrome in these patients was characterized by SVC narrowing, resulting from both extrinsic compression by the tumor mass and thrombus formation within the vein (Figure 1).



Figure 1: Computed Tomography Angiography shows heterogeneously enhancing mass lesion in Right upper lobe (asterisk in A & C) which is causing extrinsic compression and significant stenosis of Superior Vena Cava (white arrows). There is multiple liver metastasis noted (black arrow in C)

- Symptoms:

All patients presented with facial swelling (Figure 2), a classic symptom of SVC syndrome caused by impaired venous return from the head and neck region. Respiratory distress was reported in 67%

of the patients, indicating significant compromise of the respiratory function due to the vascular obstruction and associated complications.



Figure 2: This figure shows the facial swelling in two patients who presented with SVC syndrome due to lung carcinoma (A & C). Corresponding figure of respective patients after SVC stenting showing resolution of facial swelling (B & D)

Treatment Approaches:

- Local Anesthesia and Thrombectomy: All patients underwent procedures under local anesthesia, which included thrombectomy to remove the obstructive thrombus.
- Stent Placement: 83% of the patients received a single stent (Figure 3), while the remaining 17% required two stents to alleviate the SVC obstruction. Upfront stenting, performed prior to the initiation of chemotherapy, was implemented in 83% of cases. The remaining 17% of patients had stents placed after beginning chemotherapy.

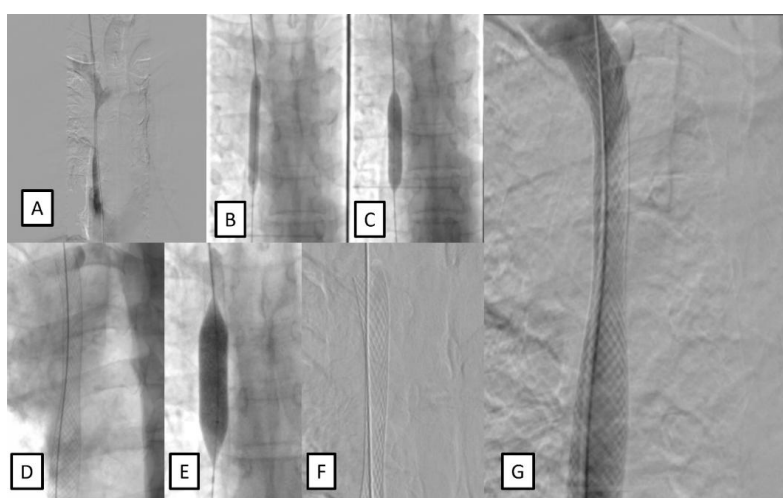


Figure 3: Digital subtraction Angiography shows (A) long segment significant narrowing of SVC just distal to joining of innominate veins. Serial ballon angioplasty by 5 mm (B) and 8 mm (C) non-complaint balloon was done. (D) Self expanding Stent of 16 * 90 (Wall stent uni, Boston Scientific) was deployed from Right Internal jugular vein access. Post stenting balloon dilatation (E) was done

by 14 mm balloon. (F) Fluoroscopy image showing expanded Stent in situ. (G) Contrast is seen to be freely flowing through the stent.

Technical success was achieved in all the patients without complications in the perioperative period in any of the patients.

All the patients had relief of symptoms such as facial swelling, dyspnea within 24 hours after the procedure (Figure 2).

At the 3-month follow-up, records were available for 10 patients, of which 9 remained symptom-free. However, one patient succumbed to death due to the progression of lung cancer. By the 6-month follow-up, data were available for 8 patients, with 6 continuing to be symptom-free. Unfortunately, two patients passed away due to the progression of lung cancer.

Discussion:

This study provides significant insights into the demographic and clinical profiles of patients with lung cancer-related superior vena cava (SVC) syndrome and the effectiveness of endovascular stenting as a treatment modality. The patient cohort predominantly consisted of older individuals, with half of the patients aged 60 years or above. This aligns with the known epidemiology of lung cancer, where incidence increases with age. The male predominance reflects the higher incidence of lung cancer in males, likely due to historical smoking patterns and occupational exposures. Histologically, the majority of cases were attributed to squamous cell carcinoma and adenocarcinoma. This distribution is consistent with the common histological subtypes of lung cancer, particularly in advanced stages.

Each patient presented with stage IV lung cancer, characterized by both extrinsic compression of the SVC by the tumor and thrombus formation, indicating a high tumor burden and significant vascular involvement. All patients experienced facial swelling, a hallmark symptom of SVC syndrome, resulting from impaired venous return. Additionally, two-thirds (67 %) of patients reported respiratory distress, further illustrating the severity of the condition and its impact on respiratory function.

The technical and clinical success rate was 100%, with no perioperative complications, underscoring the procedural safety and proficiency of the medical team. This high success rate is notable, given the complexity and critical nature of SVC syndrome in patients with advanced lung cancer. A significant finding was the rapid relief of symptoms, with all patients experiencing alleviation of facial swelling and dyspnea within 24 hours post-procedure. This immediate symptomatic relief highlights the effectiveness of endovascular stenting in restoring venous patency and improving patient quality of life.

In comparison with previous studies, our findings corroborate the established understanding of the demographics and symptomatology of SVC syndrome in lung cancer patients. Previous research has also indicated a male predominance and a higher incidence in older patients. The histological subtypes of squamous cell carcinoma and adenocarcinoma have been consistently reported in advanced lung cancer cases presenting with SVC syndrome [8].

The technical success and safety of endovascular stenting observed in our study are in line with earlier research that demonstrated similar outcomes. However, the rapid symptomatic relief within 24 hours post-procedure is a particularly noteworthy finding [9].

The results of this study have important implications for the management of SVC syndrome in lung cancer patients. The demographic and clinical profile data provide a basis for identifying patients at higher risk and tailoring early intervention strategies. The high success rate and rapid symptom relief associated with endovascular stenting support its use as a primary treatment modality in this patient population.

Additionally, the study underscores the importance of a multidisciplinary approach involving oncologists, interventional radiologists, and thoracic surgeons to optimize patient outcomes. The

integration of chemotherapy following stenting aligns with comprehensive cancer care, addressing both the mechanical obstruction and the underlying malignancy.

Conclusion:

This study confirms the efficacy and safety of endovascular stenting in the management of SVC syndrome caused by lung cancer. The procedure not only provides rapid symptomatic relief but also demonstrates a high technical success rate without any perioperative complications. These findings advocate for the broader adoption of endovascular stenting as a standard intervention for SVC syndrome in patients with advanced lung cancer, contributing to improved clinical outcomes and enhanced patient care.

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Table 1: The clinical characteristics of lung cancer patients with superior vena cava syndrome

Patient characteristics	Number of cases
Age	
< 60 years	4
> 60 years	8
Sex	
Male	11
Female	1

Histology	
Adenocarcinoma	2
Squamous cell carcinoma	8
Small cell lung carcinoma	1
Sarcoma	1
Staging	
Stage IV	12
Stenosis site	
Superior Vena Cava (SVC)	12
Causes of SVC	
Both extrinsic compression and thrombosis	12
Symptoms	
Facial swelling	12
Dyspnea	8
Both facial swelling and dyspnea	8
ECOG Performance score	
2	6
3	6

Table 2: The treatment characteristics of 12 patients receiving Stent assisted angioplasty of Superior Vena Cava

Patient characteristics	Number of cases
Anesthesia	
Local anesthesia	12
Thrombectomy	12
Number of stents	
1 stent	10
2 stents	2
Timing of stenting	
Upfront	10
After initiating chemotherapy	2
Treatments after stenting	
Chemotherapy	11