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ENDOVASCULAR TREATMENT OF SUPERIOR VENA CAVA SYNDROME : A SYSTEMATIC REVIEW

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ABSTRACT

Background: *Endovascular stenting has been used to manage superior vena cava syndrome for several decades and has become standard firstline practice. Superior vena cava (SVC) syndrome is caused by the obstruction of the SVC and can result in significant morbidity and mortality.*

Methods: *By comparing itself to the standards set by the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020, this study was able to show that it met all of cthe requirements. So, the experts were able to make sure that the study was as up-to-date as it was possible to be. For this search approach, publications that came out between 2013 and 2023 were taken into account. Several different online reference sources, like Pubmed and SagePub, were used to do this. It was decided not to take into account review pieces, works that had already been published, or works that were only half done.*

Result: *In the PubMed database, the results of our search brought up 292 articles, whereas the results of our search on SagePub brought up 315 articles. The results of the search conducted for the last year of 2013 yielded a total 163 articles for PubMed and 127 articles for SagePub. In the end, we compiled a total of 6 papers, 4 of which came from PubMed and 2 of which came from SagePub. We included six research that met the criteria.*

Conclusion: *In summary, this review confirms the effectiveness of endovascular stenting in managing SVCS. Further directions of research may include specific outcomes of endovascular stenting in benign SVCS, and the impact of procedural characteristics, such as the use of anticoagulation and type of stent used, on outcomes.*

Keyword: *Superior vena cava syndome, Endovascular therapy*

INTRODUCTION

Superior vena cava (SVC) syndrome refers to the constellation of clinical manifestations caused by obstruction of venous flow due to external compression or internal stenosis or occlusion of the SVC.[1] Superior vena cava (SVC) syndrome is caused by the severe obstruction or occlusion of the SVC and can result in significant morbidity and mortality. Malignancy is the most common cause of SVC obstruction, accounting for approximately 70% of cases. However, recently the incidence of device related SVC syndrome from central venous catheters and pacemaker or defibrillator leads has been increasing. . The management of SVC syndrome is evolving. In the past, radiation therapy (RT) was considered first-line treatment, particularly in patients with airway obstruction. However, in recent years, endovascular therapy (ET) is more frequently used first, or in combination with RT, to provide rapid relief of clinical symptoms with reduced complications.[2]

Malignancies such as primary lung cancer are the most common cause accounting for 70% of cases but the recently increased utilization of indwelling intravascular devices such as catheters, and pacemaker/defibrillator leads have led to a rise in device-related SVC syndrome. Consensus guidelines for SVC syndrome are lacking, however, traditionally treatment approach has included radiation therapy (RT) with or without chemotherapy, surgical bypass, or endovascular therapy (ET).[2]

In contemporary practice, compared to RT or surgical alternatives, ET has become the first-line treatment for the majority of patients with malignancy-related SVC. Although there are no randomized studies regarding ET in SVC syndrome, observational data have shown rapid relief of symptoms, high technical success rate, and low procedural complications.[3] Optimal treatment of device-related SVC syndrome is not well defined, but ET remains a viable first option as it does not preclude or affect the outcome of potential open surgical bypass in the future. As more patients undergo treatment with indwelling catheters, and potentially longer dwell times, the incidence of SVC syndrome is expected to increase.[4]

METHODS

Protocol

By following the rules provided by Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020, the author of this study made certain that it was up to par with the requirements. This is done to ensure that the conclusions drawn from the inquiry are accurate.

Criteria for Eligibility

For the purpose of this literature review, we review published literature of studies to acknowledge the endovascular therapy for superior vena cava syndrome. This is done to provide an explanation and improve the handling of treatment at the patient. As the main purpose of this paper, to show the relevance of the difficulties that have been identified as a whole.

In order for researchers to take part in the study, it was necessary for them to fulfil the following requirements: 1) The paper needs to be written in English. In order for the manuscript to be considered for publication, it needs to meet both of these requirements. 2) The studied papers include several that were published after 2013, but before the time period that this systematic review deems to be relevant. Examples of studies that are not permitted include editorials, submissions that do not have a DOI, review articles that have already been published, and entries that are essentially identical to journal papers that have already been published.

Search Strategy

We used "endovascular therapy" and "superior vena cava syndrome" as keywords.The search for studies to be included in the systematic review was carried out using the PubMed and SagePub databases by inputting the words: *"endovascular"[All Fields] AND ("therapeutics"[MeSH Terms] OR "therapeutics"[All Fields] OR "therapies"[All Fields] OR "therapy"[MeSH Subheading] OR "therapy"[All Fields] OR "therapy s"[All Fields] OR "therapys"[All Fields]) AND ("superior vena cava syndrome"[MeSH Terms] OR ("superior"[All Fields] AND "vena"[All Fields] AND "cava"[All Fields] AND "syndrome"[All Fields]) OR "superior vena cava syndrome"[All Fields])* used in searching the literature.

Data retrieval

After reading the abstract and the title of each study, the writers performed an examination to determine whether or not the study satisfied the inclusion criteria. The writers then decided which previous research they wanted to utilise as sources for their article and selected those studies. After looking at a number of different research, which all seemed to point to the same trend, this conclusion was drawn. All submissions need to be written in English and can't have been seen anywhere else.

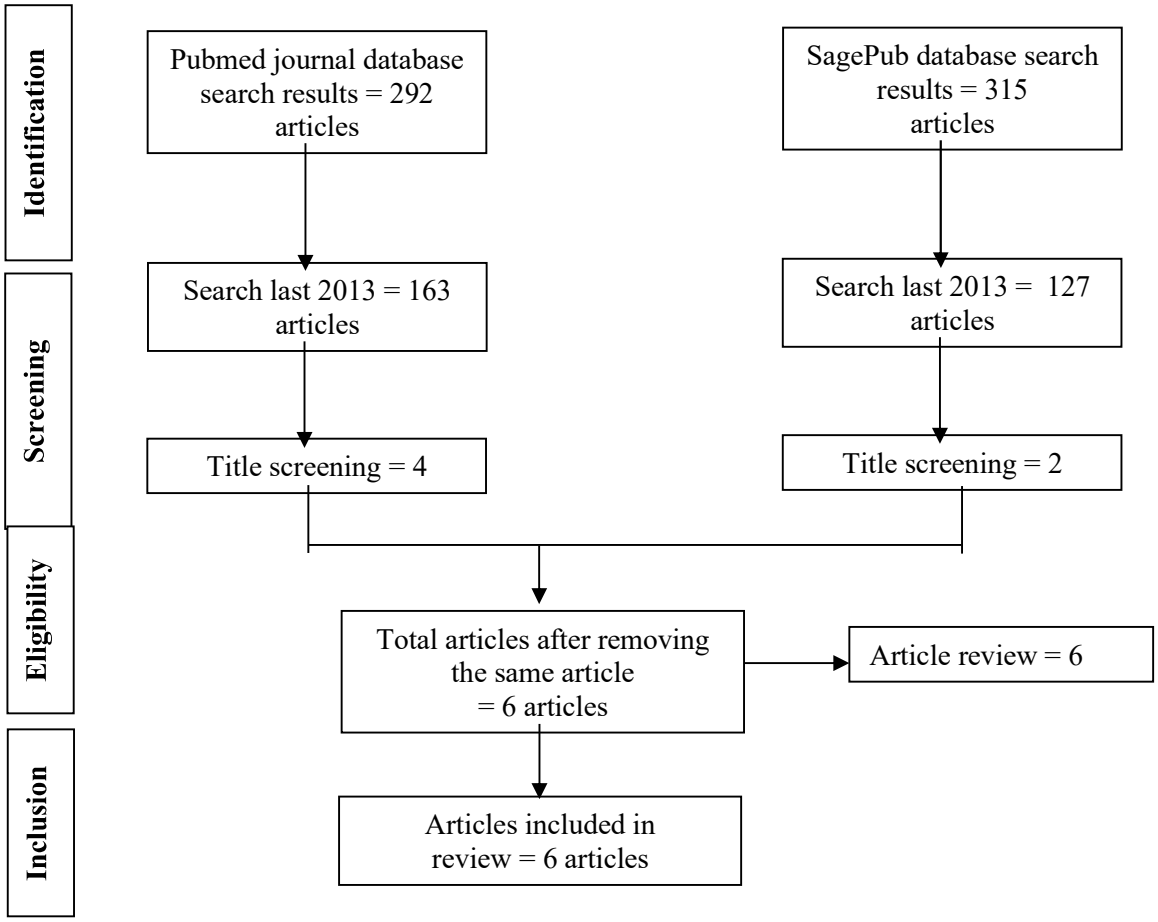

Figure 1. Article search flowchart

Only those papers that were able to satisfy all of the inclusion criteria were taken into consideration for the systematic review. This reduces the number of results to only those that are pertinent to the search. We do not take into consideration the conclusions of any study that does not satisfy our requirements. After this, the findings of the research will be analysed in great detail. The following pieces of information were uncovered as a result of the inquiry that was carried out for the purpose of this study: names, authors, publication dates, location, study activities, and parameters.

Quality Assessment and Data Synthesis

Each author did their own study on the research that was included in the publication's title and abstract before making a decision about which publications to explore further. The next step will be to evaluate all of the articles that are suitable for inclusion in the review because they match the criteria set forth for that purpose in the review. After that, we'll determine which articles to include in the review depending on the findings that we've uncovered. This criteria is utilised in the process of selecting papers for further assessment. in order to simplify the process as much as feasible when selecting papers to evaluate. Which earlier investigations were carried out, and what elements of those studies made it appropriate to include them in the review, are being discussed here.

RESULT

In the PubMed database, the results of our search brought up 292 articles, whereas the results of our search on SagePub brought up 315 articles. The results of the search conducted for the last year of 2013 yielded a total 163 articles for PubMed and 127 articles for SagePub. In the end, we compiled a total of 6 papers, 4 of which came from PubMed and 2 of which came from SagePub. We included six research that met the criteria.

Andersen, et al[5] (2014) showed that the stent treatment for superior vena cava syndrome is a safe treatment with good clinical effect in patients with superior vena cava syndrome in the terminal phase of malignant disease. In this small patient population, no trends were observed which would suggest that outcomes vary by stent type, though additional, large-scale studies are needed.

Cho, et al[6] (2014) showed that unilateral covered stent placement appears to be a safe and effective method for treating malignant SVC syndrome, despite the location of SVC occlusion.

Haddad, et al[7] (2021) showed that both covered and uncovered stents can be used for treating benign SVC syndrome. Covered stents, however, may be a more effective option at providing symptom relief and maintaining stent patency if validated by further studies.

Table 1. The litelature include in this study

Author	Origin	Method	Sample	Result
Andersen et al, 2014[5]	Denmark	Retrospective study	25 patients	It was seen that the procedural success rate was 76% with all stents deployed as intended and no procedure-related complications but in five patients with 50% residual stenosis and one patient with stent occlusion within 48 hours after stent deployment. Stent occlusion occurred in further two patients during follow-up: one patient developed infection, thrombosis, and occlusion in the stent seen at 2-month follow-up, and one patient had stent occlusion at 4-month follow-up. The clinical success rate was 96%. Stent compression leading to a greater than 50% reduction in stent diameter was observed in three patients at follow-up. Overall 22 patients died at a mean follow-up of 3.5 months for reasons related to their underlying malignancy.
Cho et al, 2014[6]	South Korea	Retrospective study	37 patients	Stent placement was technically successful in all patients. There were no major complications. Of the 37 patients symptomatic prior to stent placement, 34 (92%) experienced complete symptomatic relief 1-8 days after stent placement. Of the 29 patients who underwent covered stent placement across the venous confluence, nine patients had patent contralateral brachiocephalic veins prior to stent placement. However, no sign of SVC obstruction or contralateral upper extremity venous thrombosis was observed during the follow-up period. Kaplan-Meier analysis revealed median patient survival of 163 days. Stent occlusion occurred in four (10%) of 40 patents. Cumulative stent patency rates at 1, 3, 6, and 12 months were 95%, 92%, 86%, and 86%, respectively.

Haddad et al, 2021[7]	USA	Retrospective study	47 patients	There was a significant difference (p = 0.044) in the number of patients who reported a return of symptoms between the covered (5/17 or 29.4%) and uncovered (18/30 or 60%) groups. There was also a significant difference (p = < 0.001) in the mean percent stenosis after stent placement between the covered [17.9% (range 0–100) ± 26.2] and uncovered [48.3% (range 6.8–100) ± 33.5] groups. No significant difference (p = 0.227) was found in the time (days) between the date of the procedure and the date of clinical follow-up where a return of symptoms was reported [covered: 426.6 (range 28–1554) ± 633.9 and uncovered 778.1 (range 23–3851) ± 1066.8]. One patient in the uncovered group had non-endovascular surgical intervention (innominate to right atrial bypass), while none in the covered group required surgical intervention. One major complication (SIR grade C) occurred that consisted of a pericardial hemorrhagic effusion after angioplasty that required covered stent placement.
Karakhanian et al, 2019[8]	Brazil	Retrospective study	28 patients	Superior vena cava occlusion repair was not possible in one oligosymptomatic patient with a very severe lesion. Technical success was achieved in 96.4%. There were two deaths, one due to pulmonary embolism, 24 hours after a successful procedure, and the other due to compression of the airways by tumor mass some hours after the procedure. Clinical success was achieved in all cases of technical success, including one patient who died suddenly, after total regression of SVCS symptoms. Symptoms disappeared 24 hours and 48 hours after management in16 and 8 patients respectively; improvement was slower but progressive after 48 hours in the remaining patients.
McDevitt et al, 2021[9]	USA	Retrospective study	137 patients	In total, 208 Z-stents were placed. The three most

				common placement sites were the inferior vena cava (n=124, 59.6%), superior vena cava (n=44, 21.2%), and brachiocephalic veins (n=27, 13.0%). Technical success was achieved in 133 patients (97.1%). There were two (1.5%) severe adverse events (two cases of stent migration to the right atrium), one (0.7%) moderate adverse event, and one (0.7%) mild adverse event. Mean follow-up was 43.6±52.7 months. Estimated 1-, 3-, and 5-year primary stent patency was 84.2%, 84.2%, and 82.1%, respectively. Estimated 1-, 3-, and 5-year primary-assisted patency was 92.3%, 89.6%, and 89.6%, respectively. The 30- and 60- day mortality rates were 2.9% (n=4) and 5.1% (n=7), none of which were directly attributable to Z-stent placement.
Irace et al, 2021[10]	Italy	Retrospective study	42 patients	Thirty-four (81%) patients had a nonresectable lung tumour invading or compressing the SVC. Five (12%) patients had a non-Hodgkin's lymphoma, and three (7%) had metastatic lymphadenopathies. Nitinol stents (Memotherm®) were employed in 19 (45%) patients, and steel stents (Wallstent™) in the remaining 23 (55%) patients. Thirty-five (85%) patients died during follow up for disease progression and the overall survival rate at 24 months was 11% (standard error (SE)=0.058). Thirteen patients (32%) had a recurrence of SVCS because of stent thrombosis in three (23%) and extrinsic compression from uncontrolled cancer progression in ten (77%). The overall symptom-free interval at 24 months was 57% (SE=0.095).

Karakhanian, et al[8] (2019) showed that endovascular stent placement was effective for management of SVCS, with good technical and clinical success rates and provided prompt relief from symptoms.

McDevitt, et al[9] (2021) showed that Gianturco Z-stent placement is safe and effective for the treatment for chronic central venous occlusive disease with durable short- and long-term patencies.

Irace, et al[10] (2021) showed that it is recommended to use the endovascular procedure as a first-line treatment in locally advanced or metastatic tumour in the presence of SVCS.

DISCUSSION

The treatment approach in patients with SVC syndrome is multidisciplinary and treatment options include radiation therapy (RT) with or without chemotherapy, surgical bypass, or ET such as angioplasty, stenting, and catheter-based thrombus removal. The findings of our systematic review lend credence to ET as first-line treatment for SVC syndrome as it provides a rapid resolution of symptoms, high technical success, low restenosis and recurrence rates, with low intra- and post-procedural complications. Generally, SVC obstruction is categorized into four types using the Stanford and Doty Classification system based on major venographic patterns with each type associated with progressively advanced obstruction and development of collateral venous systems.[2]

In many cases of SVC syndrome, there may also be superimposed thrombosis and to address this, CDT and/or aspiration thrombectomy can be performed prior to revascularization. The use of ET in SVC syndrome has not previously been examined in a formal meta-analysis, however, existing research demonstrating its efficacy is well-documented in a review from 2014. Since then, more studies have continued to support the use of ET as the preferred treatment option for SVC syndrome. Although the study did not meet our inclusion criteria, a recent small RCT by Takeuchi et al. examined stent placement among 32 patients with SVC or inferior vena cava occlusion. This trial demonstrated statistically significant improvements in symptom scores among the ET group as compared to control.[11]

Even among more uncommon etiologies of SVC syndrome such as mediastinal fibrosis (MF) for which the role of ET is not well documented, evidence for its use is building. Recent studies have reported success in the use of ET to treat MF associated SVC syndrome. Although spiral vein bypass grafting has traditionally been the first-line therapy for SVC syndrome in MF, some authors suggest a multidisciplinary approach in which ET is first-line intervention and open surgical reconstruction reserved for MF associated SVC syndrome that is refractory to ET.[12]

The role of anticoagulation after revascularization of SVC has not been well studied. In the absence of notable thrombosis, the role of anticoagulation is not well established. Anticoagulation regimen for reported studies were variable and included oral anticoagulants, anti-platelet agents, or parenteral anticoagulants. Bleeding risk and outcomes based on etiology of SVC syndrome was not reported.[5]

When SVC obstruction occurs with bilateral brachiocephalic vein involvement, relieving the obstruction in one of the occluded brachiocephalic veins is often sufficient for symptom resolution. Recanalization and stenting of one instead of both brachiocephalic veins with “kissing stents” were associated with lower rates of complications and stent thrombosis.[5]

This systematic review demonstrate high technical success rates, low restenosis rates, and low recurrence rates following ET for SVC syndrome thus supporting the paradigm of ET as a first-line treatment of SVC syndrome for both malignant and benign etiologies. This study provides the most contemporary and cumulative evidence for the safety and efficacy of ET in the management of SVC syndrome. As the modern endovascular techniques evolve, we believe that the outcomes will continue to improve, however, there is a need for continued research on the use of ET in SVC syndrome such as larger nationwide cohort studies and RCTs.

CONCLUSION

In summary, this review confirms the effectiveness of endovascular stenting in managing SVCS. Further directions of research may include specific outcomes of endovascular stenting in benign SVCS, and the impact of procedural characteristics, such as the use of anticoagulation and type of stent used, on outcomes.

REFERENCE

[1] Friedman T, Quencer KB, Kishore SA, Winokur RS, Madoff DC. Malignant Venous Obstruction: Superior Vena Cava Syndrome and Beyond. Semin Intervent Radiol. 2017;34(4):398–408.

[2] Azizi AH, Shafi I, Shah N, Rosenfield K, Schainfeld R, Sista A, et al. Superior Vena Cava Syndrome. Vol. 13, JACC: Cardiovascular Interventions. Elsevier Inc.; 2020. p. 2896–910.

[3] Fagedet D, Thony F, Timsit JF, Rodiere M, Monnin-Bares V, Ferretti GR, et al. Endovascular treatment of malignant superior vena cava syndrome: results and predictive factors of clinical efficacy. Cardiovasc Intervent Radiol. 2013;36(1):140–9.

[4] Hooker JB, Hawkins BM, Abu-Fadel MS. Endovascular Stenting in 2 Patients with Benign Superior Vena Cava Syndrome. Tex Heart Inst J [Internet]. 2018 [cited 2023 Dec 27];45(4):264–9. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6183629/

[5] Andersen PE, Duvnjak S. Palliative Treatment of Superior Vena Cava Syndrome with Nitinol Stents. Int J Angiol. 2014;23(4):255–62.

[6] Cho Y, Gwon DI, Ko GY, Ko HK, Kim JH, Shin JH, et al. Covered Stent Placement for the Treatment of Malignant Superior Vena Cava Syndrome: Is Unilateral Covered Stenting Safe and Effective? Korean J Radiol. 2014;15(1):87–94.

[7] Haddad MM, Simmons B, McPhail IR, Kalra M, Neisen MJ, Johnson MP. Comparison of Covered Versus Uncovered Stents for Benign Superior Vena Cava (SVC) Obstruction. Cardiovasc Intervent Radiol. 2018;41(5):712–7.
[8] Karakhanian WK, Karakhanian WZ, Belczak SQ. Superior vena cava syndrome: endovascular management. J Vasc Bras. 2019;
[9] McDevitt JL, Goldman GT, Bundy JJ, Hage AN, Jairath NK, Gemmete JJ, et al. Gianturco Z-stent placement for the treatment of chronic central venous occlusive disease: implantation of 208 stents in 137 symptomatic patients. Diagn Interv Radiol. 2021;27(1):72–8.
[10] Irace L, Martinelli O, Gattuso R, Mingoli A. The role of self-expanding vascular stent in superior vena cava syndrome for advanced tumours. Ann R Coll Surg Engl. 2021;103(4):296–301.
[11] Rachapalli V, Boucher LM. Superior vena cava syndrome: role of the interventionalist. Can Assoc Radiol J. 2014;65(2):168–76.
[12] Deshwal H, Ghosh S, Magruder K, Bartholomew JR, Montgomery J, Mehta AC. A review of endovascular stenting for superior vena cava syndrome in fibrosing mediastinitis. Vasc Med. 2020;25(2):174–83.