CardioVascular and Interventional Radiology

© Springer Science+Business Media, Inc. 2006
Published Online: 17 February 2006

Cardiovasc Intervent Radiol (2006) 29:319–322
DOI: 10.1007/s00270-005-0284-9

CIRSE GUIDELINES

Quality Assurance Guidelines for Superior Vena Cava Stenting in Malignant Disease

Raman Uberoi

Department of Radiology, The John Radcliffe Hospital, Headley Way, Headington, Oxford OX3 9DU, UK

Abstract

Superior vena cava stenting for the treatment of malignant superior vena cava obstruction is now well established. It offers simple, rapid, and safe palliation of a distressing and potentially fatal complication of mediastinal malignant disease and compares very favorably with standard therapies such as chemotherapy and radiotherapy. The following are quality assurance guidelines for superior vena cava stenting.

Key words: Interventional radiology—Lung neoplasm—Stenting—Superior vena cava

Stenting of the superior vena cava (SVC) for obstruction was first described by Charnsangavej et al. in 1986 [1]. Since then, it has become the standard treatment for this condition. The current main clinical indication for SVC stenting is the alleviation of superior vena cava obstruction (SVCO) caused by malignant obstruction of the SVC. Untreated this may result in severe edema of the upper torso and patients may suffocate due to glottal edema. Other symptoms such as dyspnea, dysphagia, cognitive dysfunction, and severe headaches may also occur in SVCO. Malignant causes account for in excess of 90% of cases of SVCO [2]. Most commonly this is due to carcinoma of the bronchus (small cell and non-small cell) and SVCO affects 3–4% of patients with bronchogenic cancer. SVCO appears to be more common with squamous cell lung carcinoma (SCLC) than non-squamous cell lung carcinoma (NSCLC). The incidence of SVCO at diagnosis in a recent review was 10% for SCLC and 1.7% for NSCLC [3]. Less commonly lymphoma, metastatic disease, and other intrathoracic tumors such as mesothelioma and thymoma may be responsible.

Correspondence to: Raman Uberoi; *email:* raman.uberoi@orh.nhs.uk

The diagnosis of SVCO is usually made clinically at first. The most common features are neck swelling, unilateral or bilateral arm swelling, and distended veins over the chest [4, 5]. Shortness of breath, hoarse voice, and headache may also be caused by SVCO although these symptoms may arise from other manifestations of lung cancer. SVCO results from the compression of the SVC by either a tumor arising in the right main or upper lobe bronchus or by large-volume mediastinal lymphadenopathy. Symptoms tend to be more severe when the SVC is obstructed below the entry of the azygos vein. Contrast-enhanced spiral or multislice computed tomography (CT) can identify with accuracy the site of obstruction and the presence of thrombosis. Impending SVCO may be also be apparent on CT or magnetic resonance imaging imaging prior to the development of symptoms [6]. Venography, which is usually carried out before stenting, is the gold standard for the detection of SVCO and also demonstrates the extent of any thrombus formation.

In the past, SVCO has been considered a medical emergency in all patients. For the majority of patients, this is now believed not to be the case as outcome is unrelated to duration of symptoms [7, 8]. The severity of symptoms of SVCO is increased by airway obstruction from laryngeal or bronchial edema or coma from cerebral edema. If patients with SVCO present with depressed central nervous system function or dyspnea, stenting should be performed emergently.

Other treatments such as steroids and radiotherapy, although effective for SVCO, take time to work [9–12]. Stenting of malignant SVCO provides rapid relief of symptoms and should be performed if severe symptoms of SVCO occur [12–52].

Indications

SVCO syndrome due to malignant obstruction of the SVC.

Contraindications

There are no absolute contraindications.

Relative Contraindications

- Malignancies with a very good chance of cure or remission.
- Benign disease: stenting should be avoided if at all possible because patients have long life expectancies and occlusion of the stent would be expected during long-term follow-up.

Technique

The procedure is usually performed using conscious sedation and local anesthesia. Standard monitoring should be used with assessment of the heart rate, blood pressure (BP), oxygen saturation, and electrocardiography. Superior vena cavography should be performed first to confirm the disease extent and to define the landing zones for stents, i.e., patency of brachiocephalic veins and/or proximal and distal SVC. Most operators prefer to use either the femoral vein or the jugular vein as access sites. The basilic or subclavian veins can also be used as access if the operator prefers, or if the standard access sites are unavailable or occluded [13]. Ultrasound guidance is generally used when the jugular vein is used for access. Ultrasound should also be used for difficult punctures at other sites.

Many interventionalists administer heparin as a bolus of 5000 units of heparin during the procedure; however, this practice is not universal [14]. If there is extensive thrombus, local thrombolysis can be carried out to reduce the length of the obstruction and hence the number and length of stents required, and the risk of emboli [15–20]. Thrombus can also be removed by mechanical thrombectomy although this technique is used less than thrombolysis.

The obstruction can usually be crossed using a combination of selective catheters such as the cobra, Berenstein, and multipurpose (all Cordis, Johnson & Johnson, NJ, USA), and a variety of standard or hydrophilic guidewires such as the Terumo glidewire (Terumo, Japan) and Bentsen (William Cook Europe, Bjaeverskov, Denmark). If it is not possible to traverse the stricture from one direction (e.g., from a femoral vein access), the other direction (i.e., access from the jugular vein) should be tried. Once the lesion has been traversed, the standard or hydrophilic guidewire should be exchanged for a 180 cm long or 260 cm long stiff or ultrastiff guidewire.

Predilatation of the stricture may be necessary, to allow passage of the stent delivery system, but should not be done if there is residual thrombus. There is no consensus on the size of balloon required for predilation [21–24]. Most interventionalists either use a diameter of balloon equivalent to the vein being dilated or use a smaller balloon just to facilitate passage of the stent delivery system. Care should be exercised when performing balloon dilation because venous rupture is an uncommon, though occasionally catastrophic occurrence [24]. Rupture of the SVC may result in cardiac tamponade. For this reason, facilities for pericardial drainage should be available in the room to allow emergent pericardiocentesis in case of cardiac tamponade after rupture of the central veins.

There appears to be no significant difference in the published outcomes of the three most commonly used stents: the Gianturco Z-stent, the Palmaz stent (Johnson & Johnson, Warren, NJ, USA) and the Wallstent (Boston Scientific, Natick, MA, USA) [25–28]. Most interventionalists use self-expanding stents due to their greater length and improved adaptability to the curves of the vessels. There are several new self-expanding stents available, such as the Luminex (Bard Angiomed, Karlsruhe, Germany) and Smart (Cordis), although there is little data on their use in the SVC.

A stent of sufficient length should be selected to cover the occlusion with at least 10 mm free at both ends to extend beyond the obstruction. More than one stent should be used if adequate coverage cannot be achieved with a single stent. The roadmap feature is useful to guide accurate deployment of the stent and should be used if available on the angiography equipment. The roadmap should be performed using injections from both sides of the obstruction, if sufficient visualization of both sides cannot be achieved with a single injection from above the lesion.

Where there is obstruction of both brachiocephalic veins and the SVC, it is sufficient to relieve the obstruction in one of the brachiocephalic veins, with collateral veins enabling drainage from both sides. Although stenting of both brachiocephalic veins is advocated by some interventionalists, there are reports suggesting that it may result in higher complication rates and lower survival [12, 14, 29].

Dilation of the stent after deployment is often required to assist full stent expansion.

A completion venogram is carried out to confirm satisfactory positioning of the stent with free venous drainage and to exclude venous rupture.

Aftercare

Patients should remain in bed for at least 2 hr after the procedure. They should be monitored regularly with pulse and BP monitoring every 15 min for the first hour, then half-hourly for the second hour.

The need for long-term anticoagulants remains unclear. Although full anticoagulation has been carried out by many authors to prevent stent occlusion for periods of 1–9 months [19, 28–30], this remains controversial, with some advocating simple antiplatelet regimes [14, 31]. There are no routine follow-up imaging protocols in the literature other than plain films to assess stent expansion and as a baseline in case of future stent migration [14, 28, 32]. Most patients are usually followed up clinically by their referring clinicians. Repeat venography should be carried out if symptoms recur. If recurrent obstruction is present, patients should undergo repeat stenting.

Table 1. Outcomes of SVC stenting in malignant disease

	Technical success	Clinical success	Recurrence	Complications	Mortality
Range	95–100%	80–95%	0–40%	0–19%	3–4%
Mean	99%	96%	13%	5.8%	3.3%

Data from [12–52]

Outcomes

The technical and clinical success rates of SVC stenting are high (Table 1). Technical success is in the range of 95–100% and stents relieve SVCO in 80–95% of patients. Reported recurrence rates vary between 0 and 40% during follow-up (3 days to 8 months); however, in a high proportion of patients patency is restored with reintervention [12–52]. These results compare favorably with the results of chemotherapy or radiotherapy. A recent review concluded that stenting seems to be the most effective and rapid treatment for the relief of symptoms [3].

Complications

Periprocedural and postprocedural complications are low, occurring in 0–19% of patients [12–52] (Table 1). These include SVC rupture, hemorrhage, hemoptysis, epistaxis, pericardial tamponade, cardiac failure, recurrent laryngeal palsy, stent migration, pulmonary emboli, and groin hematoma. Overall these complications compare very favorably with treatment with chemotherapy and radiotherapy [3].

Conclusion

Superior vena cava stenting has become widely accepted in the management of malignant superior vena cava obstruction. Outcomes and complications compare very favorably with standard therapies such as chemotherapy and radiotherapy.

References

1. Charnsangavej C, Carrasco CH, Wallace S, et al. (1986) Stenosis of the vena cava: Preliminary assessment of treatment with expandable metal stents. Radiology 161:295–298
2. Ostler PJ, Clarke DP, Watkinson AF, Gaze MN (1997) Superior vena cava obstruction: A modern management strategy. Clin Oncol 9:83–89
3. Rowell NP, Gleeson FV (2002) Steroids, radiotherapy, chemotherapy and stents for superior vena caval obstruction in carcinoma of the bronchus: A systematic review. Clin Oncol 14:338–351
4. Rosenbloom SE (1949) Superior vena cava obstruction in primary cancer of the lung. Ann Intern Med 31:470–478
5. Stanford W, Jolles H, Ell S, Chiu LC (1987) Superior vena cava obstruction: A venographic classification. AJR Am J Roentgenol 148:259–262
6. Bechtold RE, Wolfman NT, Karstaedt N, Choplin RH (1985) Superior vena caval obstruction: Detection using CT. Radiology 157:485–487
7. Gauden SJ (1993) Superior vena cava syndrome induced by bronchogenic carcinoma: Is this an oncologic emergency? Australas Radiol 37:363–366
8. Schraufnagel DE, Hill R, Leech JA, Pare JAP (1981) Superior vena caval obstruction. Is it a medical emergency? Am J Med 70:1169–1174
9. Howard N (1961) Factors affecting prognosis in superior vena caval obstruction due to bronchial carcinoma. Clin Radiol 12:295–298
10. Perez CA, Presant CA, van Amburg AL (1978) Management of superior vena cava syndrome. Semin Oncol 5:123–134
11. Urban T, Lebeau B, Chastang C, Leclerc P, Botto MJ, Sauvaget J (1993) Superior vena cava syndrome in small cell lung cancer. Arch Intern Med 153:384–387
12. Nicholson AA, Ettles DF, Arnold A, Greenstone M, Dyet JF (1997) Treatment of malignant superior vena cava obstruction: Metal stents or radiation therapy. J Vasc Interv Radiol 8:781–788
13. Miller JH, McBride K, Little F, Price A (2000) Malignant superior vena cava obstruction: Stent placement via the subclavian route. Cardiovasc Intervent Radiol 23:155–158
14. Lanciego C, Chacon JL, Julian A, et al. (2001) Stenting as first option for endovascular treatment of malignant superior vena cava syndrome. AJR Am J Roentgenol 177:585–593
15. Tanigawa N, Sawada S, Mishima K, et al. (1998) Clinical outcome of stenting in superior vena cava syndrome associated with malignant tumours. Acta Radiol 39:669–674
16. Crowe MTI, Davies CH, Gaines PA (1995) Percutaneous management of superior vena cava occlusions. Cardiovasc Intervent Radiol 18:367–372
17. Edwards RD, Cassidy J, Taylor A (1992) Case report: Superior vena cava obstruction complicated by central venous thrombosis: treatment with thrombolysis and Gianturco Z-stents. Clin Radiol 45:278–280
18. Edwards RD, Jackson JE (1993) Case report: Superior vena caval obstruction treated by thrombolysis, mechanical thrombectomy and metallic stents. Clin Radiol 48:215–217
19. Stock KW, Jacob AL, Proske M, Bolliger CT, Rochlitz C, Steinbrich W (1995) Treatment of malignant obstruction of the superior vena cava with the self-expanding Wallstent. Thorax 50:1151–1156
20. Kee ST, Kinoshita L, Razavi MK, Nyman URO, Semba CP, Dake MD (1998) Superior vena cava syndrome: Treatment with catheter-directed thrombolysis and endovascular stent placement. Radiology 206:187–193
21. Rosch J, Uchida BT, Hall LD, et al. (1992) Gianturco-Rosch expandable Z-stents in the treatment of superior vena cava syndrome. Cardiovasc Intervent Radiol 15:319–327
22. Smayra T, Otal P, Chabbert V, et al. (2001) Long term results of endovascular stent placement in the superior caval venous system. Cardiovasc Intervent Radiol 24:388–394
23. Brown KT, Getrajdamn GI (2005) Balloon dilatation of the superior vena cava (SVC) resulting in SVC rupture and pericardial tamponade: A case report and brief review. Cardiovasc Intervent Radiol 28:372–376
24. Zollikofer CL, Antonucci F, Stuckmann, Mattias P, Bruhlmann WF, Salomonowitz EK (1992) Use of the Wallstent in the venous system including haemodialysis-related stenosis. Cardiovasc Intervent Radiol 15:334–341
25. Elson JD, Becker GJ, Wholey MH, Ehrman KO (1991) Vena caval and central venous stenoses: Management with Palmaz balloon expandable intraluminal stents. J Vasc Interv Radiol 2:215–223
26. Oudkerk M, Kuijpers TJA, Schmitz PIM, Loosveld O, de Wit R (1996) Self-expanding metal stents for palliative treatment of superior vena caval syndrome. Cardiovasc Intervent Radiol 19:146–151
27. Entwisle KG, Watkinson AF, Reidy J (1996) Case report: Migration and shortening of a self-expanding metallic stent complicating the treatment of malignant superior vena cava stenosis. Clin Radiol 51:593–595
28. Hennequin LM, Fade O, Fays JG, et al. (1995) Superior vena cava stent placement: Results with the Wallstent endoprosthesis. Radiology 196:353–361
29. Dinkel HP, Mettke B, Schmid F, et al. (2003) Endovascular treatment of malignant superior vena cava syndrome: Is bilateral Wallstent placement superior to unilateral placement? J Endovasc Ther 10:788–797
30. Urruticoechea A, Mesia R, Dominquez J, et al. (2004) Treatment of malignant superior vena cava syndrome by endovascular stent insertion: Experience on 52 patients with lung cancer. Lung Cancer 43:209–214
31. Gross CM, Kramer J, Waigand J, et al. (1997) Stent implantation in patients with superior vena cava syndrome. AJR Am J Roentgenol 169:429–432

32. Kishi K, Sonomura T, Mitsuzane K, et al. (1993) Self-expandable metallic stent therapy for superior vena cava syndrome: Clinical observations. Radiology 189:531–535
33. Irving JD, Dondelinger RF, Reidy JF, et al. (1992) Gianturco selfexpanding stents: Clinical experience in the vena cava and large veins. Cardiovasc Intervent Radiol 15:328–333
34. Watkinson AF, Hansell DM (1993) Expandable Wallstent for the treatment of obstruction of the superior vena cava. Thorax 48:915–920
35. Carrasco CH, Charnsangavej C, Wright KC, Wallace S, Gianturco C (1992) Use of the Gianturco self-expanding stent in stenoses of the superior and inferior venae cavae. J Vasc Interv Radiol 3:409–419
36. Chin DH, Petersen BD, Timmermans H, Rosch J (1996) Stent-graft in the management of superior vena cava syndrome. Cardiovasc Intervent Radiol 19:302–304
37. Dyet JF, Nicholson AA, Cook AM (1993) The use of the Wallstent endovascular prosthesis in the treatment of malignant obstruction of the superior vena cava. Clin Radiol 48:381–385
38. Eng J, Sabanathan S (1993) Management of superior vena cava obstruction with self-expanding intraluminal stents. Two case reports. Scand J Thorac Cardiovasc Surg 27:53–55
39. Furui S, Sawada S, Kuramoto K, et al. (1995) Gianturco stent placement in malignant caval obstruction: Analysis of factors for predicting the outcome. Radiology 195:147–152
40. Gaines PA, Belli A-M, Anderson PB, McBride K, Hemingway AP (1994) Superior vena caval obstruction managed by the Gianturco Z stent. Clin Radiol 49:202–208
41. Oderich GSC, Treiman GS, Schneider P, Bhirangi K (2000) Stent placement for treatment of central and peripheral venous obstruction: A long-term multi-institutional experience. J Vasc Surg 32:760–769
42. Oudkerk M, Heystraten FMJ, Stoter G (1993) Stenting in malignant vena caval obstruction. Cancer 71:142–146
43. Putnam JS, Uchida BT, Antonovic R, Rosch J (1998) Superior vena cava syndrome associated with massive thrombosis: Treatment with expandable wire stents. Radiology 167:727–728
44. Rosch J, Bedel JE, Putnam J, Antonovic R, Uchida B (1987) Gianturco expandable wire stents in the treatment of superior vena cava syndrome recurring after maximum tolerance radiation. Cancer 60:1243–1246
45. Thony F, Moro D, Witmeyer P, et al. (1999) Endovascular treatment of superior vena cava obstruction in patients with malignancies. Eur Radiol 9:965–971
46. Wilson E, Lyn E, Lynn A, Khan S (2000) Radiological stenting provides effective palliation in malignant central venous obstruction. Clin Oncol 12:331
47. Shah R, Sabanathan S, Lowe RA, Mearns AJ (1996) Stenting in malignant obstruction of superior vena cava. J Thorac Cardiovasc Surg 112:335–340
48. Antonucci F, Salomonowitz E, Stuckmann G, Stiefel M, Largiader J, Zollikofer CL (1992) Placement of venous stents: Clinical experience with a self-expanding prosthesis. Radiology 183:493–497
49. Dondelinger RF, Goffette P, Kurdziel J-C, Roche A (1991) Expandable metal stents for stenoses of the vena cava and large veins. Semin Intervent Radiol 8:252–263
50. Sawada S, Fujiwara Y, Koyama T, et al. (1992) Application of expandable metallic stents to the venous system. Acta Radiol 33:156–159
51. Solomon N, Wholey MH, Jarmolowski CR (1991) Intravascular stents in the management of superior vena cava syndrome. Cathet Cardiovasc Diagn 23:245–252
52. Wilkinson P, MacMahon J, Johnston L (1995) Stenting and superior vena caval syndrome. Ir J Med Sci 164:128–131