



■ ONCOLOGY

A vessel sealing system can help reduce the risk of postoperative complications after tumour resection in the medial thigh

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Aims

The risk of postoperative complications after resection of soft-tissue sarcoma in the medial thigh is higher than in other locations. This study investigated whether a vessel sealing system (VSS) could help reduce the risk of postoperative complications after wide resection of soft-tissue sarcoma in the medial thigh.

Methods

Of 285 patients who underwent wide resection for soft-tissue sarcoma between 2014 and 2021 at our institution, 78 patients with tumours in the medial thigh were extracted from our database. Information on clinicopathological characteristics, preoperative treatment, surgical treatment (use of VSS, blood loss volume, operating time), and postoperative course (complications, postoperative haemoglobin changes, total drainage volume, and drainage and hospitalization durations) were obtained from medical records. We statistically compared clinical outcomes between patients whose surgery did or did not use VSS (VSS and non-VSS groups, respectively).

Results

There were 24 patients in the VSS group and 54 in the non-VSS group. There were no significant differences between the two groups in terms of clinicopathological background. The total drainage volume in the VSS group was significantly less than that in the non-VSS group (1,176 ml vs 3,114 ml; $p = 0.018$). Moreover, the drainage and hospitalization durations were significantly shorter in the VSS group compared to the non-VSS group ($p = 0.017$ and $p = 0.024$, respectively).

Conclusion

Our results suggest that use of VSS can help reduce the risk of postoperative complications after wide resection of soft-tissue sarcoma in the medial thigh.

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Introduction

Complete tumour resection with a wide surgical margin is a mainstay of treatment for soft-tissue sarcoma (STS), though the complication rate after wide resection of STS has been reported to range from 36% to 50%.¹⁻³ Notably, patients who undergo wide resection of STS in the medial thigh (an adductor compartment of the thigh) have more frequent complications than those with STS in other locations.^{2,4} Moore et al⁵ reported

that because part of the lymphatic drainage system of the lower limb is located in the adductor compartment of the thigh, significant wound complications in patients with STS usually occur in this region. Therefore, some of these patients suffer from seroma, lymphedema, or wound complications such as a surgical site infection or a disruption of sutured tissue that require reoperation.

LigaSure (Medtronic, USA) is a vessel sealing system (VSS) that can seal small

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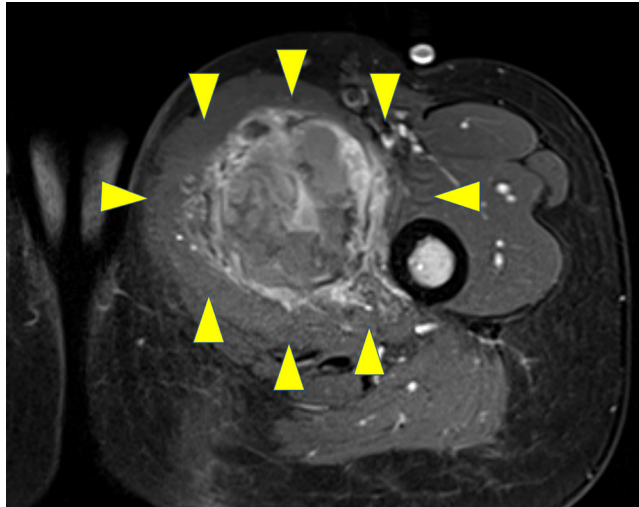


Fig. 1

Representative images of soft-tissue sarcoma arising in the medial thigh. Gadolinium-enhanced T1-weighted axial MRI images.

vessels and lymphatic ducts by denaturing the proteins of surrounding connective tissue. This device can help reduce the risk of postoperative complications after the resection of various malignancies in the medial thigh.⁶ It is particularly widely used in abdominal laparoscopic surgeries, and has been reported to reduce intraoperative blood loss and operating time.⁷ Although VSS has been commonly used in gastrointestinal surgery, it has been thought to be challenging to implement in open surgeries because of thermal injury.⁸ In recent years, reports have shown its usefulness for non-abdominal surgeries, such as thyroid surgery^{9,10} and plastic surgery.¹¹ The use of VSS is increasing in orthopaedic oncology surgery, although there are still few case series and case reports on its effectiveness.^{8,12–14} Prior to this study, it was unclear if VSS could reduce the complications caused by wide resection of STS arising in the medial thigh. Thus, we investigated this question by performing this retrospective study.

Methods

Patients. We enrolled patients with STS arising in the medial thigh who underwent definitive wide-margin resection at our hospital from 2014 to 2021. All surgeries were performed by our experienced bone and soft-tissue tumour surgeons.

Intermediate tumours, such as solitary fibrous tumour and dermatofibrosarcoma protuberans, were included if the patients underwent wide resection. Individuals who received unplanned surgery for the primary lesion and then underwent additional definitive surgery at our hospital were also included. The medial thigh was defined as the adductor compartment of the thigh based on T2-weighted or gadolinium-enhanced T1-weighted axial MRI images (Figure 1). We excluded patients with

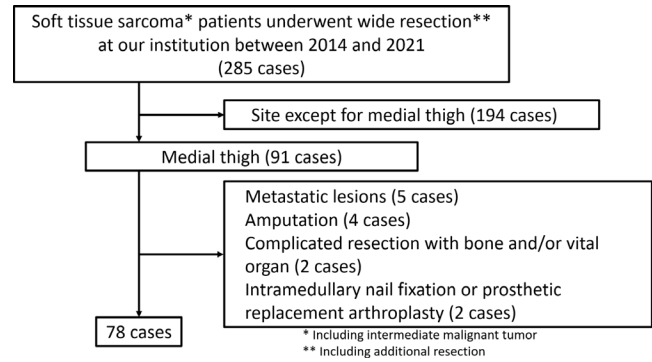


Fig. 2

Flowchart of patient selection in this study.

1) metastatic disease, 2) prior amputation, 3) additional resection of bone and/or neurovascular structures, and 4) intramedullary nail fixation or prosthetic arthroplasty.

Patient- and treatment-related variables. We identified 285 patients with STS of the thigh who underwent definitive surgery at our hospital. In total, 78 patients, comprising 46 men and 32 women, met the eligibility criteria and were enrolled in this study. A flowchart of patient selection is shown in Figure 2. Information on clinicopathological characteristics, preoperative treatment, surgical treatment (VSS use, blood loss volume, operating time), and postoperative course (complications, postoperative haemoglobin changes, total drainage volume, drainage duration, and length of hospital stay) were obtained from medical records. In all cases, we removed the drainage tube when the daily drainage volume was below 100 ml. Hospitalization duration was defined as the period between the day of operation and the day of hospital discharge. Surgical complications – specifically seroma, lymphorrhea, and infection – were evaluated based on the Common Terminology Criteria for Adverse Events (CTCAE), version 5.0.¹⁵

Statistical analysis. We used the Wilcoxon test for quantitative variables and chi-squared test to compare pairs of continuous and categorical variables, respectively. Statistical significance was defined as $p < 0.05$. Data analysis was performed using the JMP statistical software package (version 14.0.0; SAS Institute Inc., USA).

Results

The most common histological STS subtypes were myxofibrosarcoma ($n = 21$), followed by myxoid liposarcoma and undifferentiated pleomorphic sarcoma. As for comorbidities, 30 patients (38%) were diagnosed as obese ($BMI > 25 \text{ kg/m}^2$), and seven (9%) were receiving treatment for diabetes mellitus. During the study period, 12 patients received surgery for recurrent disease, and ten underwent wide resection after previously having had unplanned surgery. Creation of a musculocutaneous flap was performed after tumour resection in 28 patients,

Table I. Comparison of clinical characteristics between vessel sealing system and non-vessel sealing system groups.

Variable	VSS group	Non-VSS group	p-value
Total, n	24	54	
Mean age, yrs (SD)	56.2 (3.2)	57.4 (2.1)	0.742*
Sex (male), n (%)	12 (50)	34 (62)	0.325†
Mean BMI, kg/m ² (SD)	23.0 (0.7)	24.5 (0.5)	0.111*
Mean tumour size, cm (SD)	8.5 (1.0)	9.1 (0.6)	0.599*
Diabetic patients on medication, n (%)	2 (8)	5 (9)	1.000†
Additional resection, n (%)	5 (21)	5 (9)	0.269†
Recurrent lesion, n (%)	3 (13)	9 (17)	0.745†
Reconstruction, n (%)			
Major vessel reconstruction	5 (21)	16 (30)	0.582†
Musculocutaneous flap	10 (42)	18 (33)	0.610†
Preoperative treatment, n (%)			
Chemotherapy	6 (25)	12 (22)	0.778†
Radiotherapy	9 (38)	11 (20)	0.159†

*Wilcoxon test for quantitative variables.

†Chi-squared test.

DM, diabetes mellitus; SD, standard deviation; VSS, vessel sealing system.

while 21 patients underwent major vessel reconstruction. A total of 18 and 20 patients received preoperative chemotherapy and/or radiotherapy, respectively. There were 24 patients in the VSS group and 54 in the non-VSS group. The two groups showed no significant differences in clinicopathological backgrounds (Table I).

The operating time was almost identical in the VSS and non-VSS groups. The estimated blood loss during surgery was non-significantly lower in the VSS group than in the non-VSS group (258.0 ml (SD 101.1) vs 370.3 ml (SD 67.4); $p = 0.837$, Wilcoxon test for quantitative variables; Table II). The total drainage volume in the VSS group was significantly lower than that in the non-VSS group (1,176 ml vs 3,114 ml; $p = 0.018$, Table II). Moreover, the drainage and hospitalization durations in the VSS group were significantly shorter than those in the non-VSS group (10.2 days (SD 1.5) vs 14.8 days (SD 1.0); $p = 0.017$; and 20.4 days (SD 2.8) vs 27.1 days (SD 1.8); $p = 0.024$, respectively, Table II) Finally, the incidences of grade 3/4 complications (specifically seroma, lymphorrhea, and infection) were non-significantly lower in the VSS group than in the non-VSS group.

Discussion

In the current study, we retrospectively reviewed the clinicopathological features and peri- and intraoperative findings of 78 patients at our hospital who were treated for STS arising in the medial thigh. We aimed to determine whether the use of VSS would reduce surgery-related complications such as intra- and postoperative haemorrhage, durations of drainage and hospitalization, and surgery-related complications. Our results demonstrated that the use of VSS was significantly correlated

Table II. Comparison of clinical outcomes between the vessel sealing system and non-vessel sealing system groups.

Variable	VSS group	Non-VSS group	p-value
Total, n	24	54	
Mean operating time, mins (SD)	299.1 (32.7)	295.3 (21.8)	1.000*
Mean blood loss (SD)			
Intraoperative (ml)	258.0 (101.1)	370.3 (67.4)	0.837*
ΔHb (Preop to POD1, g/dl)	2.1 (0.3)	2.1 (0.2)	0.791*
Continuous suction drainage			
Mean total volume, ml (SD)	1,176.1 (686.5)	3,114.5 (457.6)	0.018*
Mean duration, days (SD)	10.2 (1.5)	14.8 (1.0)	0.017*
Mean hospitalization, days (SD)	20.4 (2.8)	27.1 (1.8)	0.024*
Complication (CTCAE grade 3 or 4), n (%)	3 (12)	13 (24)	0.364†
Lymphorrhea, n (%)	2 (8)	8 (15)	0.715†
Seroma, n (%)	1 (4)	7 (13)	0.423†
Infection, n (%)	2 (8)	10 (19)	0.324†
Operation due to infection, n (%)	0 (0)	6 (11)	0.169†

*Wilcoxon test for quantitative variables.

†Chi-squared test.

Hb, haemoglobin; ΔHb, changes in haemoglobin concentration; POD, postoperative day; SD, standard deviation; VSS, vessel sealing system.

with shorter durations of total drainage, continuous suction drainage, and hospitalization. On the other hand, the use of VSS did not affect intraoperative blood loss or operating time.

Two previous studies examined the usefulness of VSS in STS surgery. Levine et al⁸ performed a case-matched analysis of 142 patients (VSS: 51 patients) with STS arising in any part of body. They reported that the use of VSS reduced haemoglobin reduction and the incidence of intraoperative haemorrhage. However, there were no significant differences between the VSS and non-VSS groups regarding adverse postoperative surgical complications. Shimada et al¹² performed a retrospective study of patients with STS arising only in the lower limb and buttocks. A total of 35 patients were assigned to VSS and non-VSS groups using propensity score matching. The authors reported significantly less intraoperative bleeding but a longer operating time in the VSS group than in the non-VSS group. While these two studies showed that blood loss was significantly lower in the VSS group than in the non-VSS group, our study identified no significant difference in intraoperative blood loss between the two groups. This discrepancy could result from differences in patient characteristics between the studies. The two aforementioned studies used case-matched analysis or propensity score matching analysis to reduce selection bias, while we only included patients with STS in the medial thigh, a location associated with higher complication rates. Contrary to our expectations, intraoperative blood loss in this study was relatively low in both the VSS

and non-VSS groups, which may be why the between-group difference was not significant.

As mentioned above, our study showed that the use of VSS decreased both drainage and hospitalization durations. Because the lymphatic drainage system is well developed in the medial thigh, this location may be associated with a high risk of complications related to lymphatic drainage. In other malignancies such as breast cancer, skin cancer, and vulvar cancer, studies have investigated the usefulness of VSS for lymphadenectomy associated with axillary and ilioinguinal lesions.^{16–21} They reported that the use of VSS reduced total drainage volume and shortened the durations of continuous suction drainage and hospitalization,^{16,18–20} findings that are consistent with those of our study. Moreover, the use of VSS was shown to reduce the rate of complications.^{20,21} Although the incidence of postoperative complication such as seroma, lymphorrhea, and infection, were not reduced by VSS use in our study, we believe that they may have been lower if our sample size was larger. Since VSS is beneficial for lymphatic sealing when dissecting or ligating the adipose tissues rich in lymph vessels, the use of VSS for the resection of STSs arising in the well-developed lymphatic drainage system, including not only the medial thigh but also the axillary or ilioinguinal regions, can reduce the rate of lymphatic complications.

Previous literature did not mention whether introducing VSS into the surgery could reduce the total cost of the treatment for the patients.^{22,23} Although our study showed that the use of the VSS reduced the length of hospitalization after the surgery, it is difficult to demonstrate that the use of the VSS could contribute to the reduction in total healthcare costs. In Japan, VSS has been covered by insurance for surgery for malignant bone and soft-tissue tumours since 2018. The expected increase in the use of VSS for malignant bone and soft-tissue tumours would need further study regarding cost-effectiveness.

The primary limitations of our study are its retrospective design and the relatively small number of patients. However, enrolling only patients with STS of the medial thigh homogenized the target population. Therefore, this study demonstrates the usefulness of VSS during the resection of STS arising in this location. Further studies, including prospective randomized clinical studies, are needed.

In summary, the use of VSS in surgery for STS arising in the medial thigh reduced the total drainage volume and shortened the duration of continuous suction drainage and hospitalization.



Take home message

- A vessel sealing system reduced the total drainage volume, the duration of continuous drainage suction, and hospitalization.

- Vessel sealing system may be effective in reducing postoperative surgical-related complications. The lymphatic drainage system of the thigh is well developed in the adductor compartment.

- A vessel sealing system is recommended for wide resection of soft-tissue sarcoma in the medial thigh.

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- This study was designed as a single-institution, retrospective study and was approved by our hospital's institutional review board (2017-336). The study was conducted in agreement with the Declaration of Helsinki.

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