

## Surgical Venous Thrombectomy for Japanese Patients with Acute Deep Vein Thrombosis: A Review of 5 Years' Experience

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### Abstract

**Objective:** Deep vein thrombosis (DVT) is a major risk factor for pulmonary thromboembolism (PTE). We carefully selected patients for surgical thrombectomy to treat acute-phase thrombosis and obtained favorable results.

**Methods:** Over the past 5 years, we have performed surgical thrombectomy via a minimum femoral skin incision in 11 patients. Surgery was considered for patients with persistent phlegmasia cerulea dolens, despite thrombolytic therapy. All of our patients underwent surgery within 14 days of the onset of symptoms. During the operation, the patients were kept in the supine anti-Trendelenburg position to prevent PTE, and general anesthesia was maintained with positive-pressure mechanical ventilation. Blood flow to the inferior vena cava was occluded with a blocking catheter, and thrombectomy was performed with a thrombectomy catheter inserted parallel to the blocking catheter. A cell separator device was used effectively for autologous blood transfusion. To prevent reocclusion and promote collateral perfusion, we constructed an arteriovenous fistula for an iliac venous spur.

**Results:** There were no major postoperative complications, such as PTE or peritoneal bleeding, and no cases of postthrombotic syndrome after an average 38.4 months of follow-up.

**Conclusion:** This surgical technique for venous thrombectomy is minimally invasive and safe for Japanese patients; surgical thrombectomy should be considered a treatment option for DVT in Japan.

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**Key words:** deep vein thrombosis, thrombectomy, Japanese

### Introduction

Treatment options available for acute deep vein thrombosis (DVT) include conservative

anticoagulation, thrombolytic therapy, endovascular intervention, and surgical thrombectomy. However, complete recovery after pharmacotherapy alone is unusual, and thrombolytic therapy with urokinase or tissue plasminogen activator increases the risk of

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bleeding.

We report our experience with surgical venous thrombectomy, for which the first author received training in Germany, and the clinical outcomes of 11 Japanese patients who underwent this procedure.

### Patients and Methods

We have used a German method of surgical venous thrombectomy to operate on 11 patients in Japan, 8 of whom had DVT in the left lower extremity. The indications for surgery were persistent skin turgescence and severe pain caused by such conditions as phlegmasia cerulea dolens. We observed the "14-day rule" and performed surgery within 2 weeks of the onset of symptoms. The procedure was performed in accordance with the traditional method proposed by Heberer and van Dongen in 1989<sup>1</sup>. Intraoperative management was designed to prevent pulmonary thromboembolism (PTE); the patient was placed in the supine anti-Trendelenburg position, and general anesthesia was induced under endotracheal intubation with positive pressure ventilation (10 cm H<sub>2</sub>O). We believe this operation requires a cell separator device to prepare for autologous blood transfusion. First, a 5-cm femoral skin incision was made to expose the common femoral vein. Systemic heparinization was started with an intravenous bolus injection and continued with controlled infusion to maintain an anticoagulation time of 200 to 250 seconds. The cut-down technique was used to insert a 35-cm 8-Fr balloon catheter via the femoral vein; about 30 mL of normal saline solution was injected into the balloon to occlude the inferior vena cava.

In cases of iliofemoral occlusion, a second 7- or 8-Fr balloon catheter was inserted parallel to the occlusion catheter for optimal thrombectomy. A 4- or 5-Fr balloon catheter was also used in cases of thrombus of the lower extremity. An Esmarch bandage was then applied for hemostasis, and the milking maneuver was performed by hand (**Fig. 1**). Intraoperative venography of the pelvic veins was performed before closure of the skin incision. In cases of iliofemoral occlusion, we considered an arteriovenous fistula (A-V fistula) necessary to



Fig. 1 Positive pressure ventilation and anti-Trendelenburg position. This procedure induced a favorable venous backflow from the extremity, and large thrombi were removed (case 10).

prevent reocclusion and promote collateral perfusion. Our A-V fistulas were constructed with a branch of the greater saphenous vein in the shape of a basket handle or in the shape of the letter "N" with a polytetrafluoroethylene (PTFE) graft 4 mm in diameter.

On postoperative day 3, the continuous heparin infusion was gradually tapered and replaced with oral warfarin. Prophylaxis with warfarin was maintained for 6 to 12 months. The patients were recommended to wear a grade II elastic stocking for 6 months after surgery. The A-V fistulas were closed in the third month after surgery with the patients under local anesthesia.

### Results

**Table 1** shows the 11 patients' characteristics and outcomes. At the time of surgery, the patients (8 men and 3 women) ranged in age from 31 to 75 years (average, 50.2 years). Eight of the patients had acute DVT in the left lower extremity. The common iliac vein was involved in 7 patients, for each of whom an A-V fistula was constructed. All patients underwent surgery within 2 weeks of the onset of symptoms (average: 7.9 days).

The surgical indications included persistent phlegmasia cerulea dolens despite thrombolytic therapy in 1 patient, unsuccessful urokinase fibrinolysis or catheter-directed thrombolysis in 6

## Surgical Venous Thrombectomy

Table 1 Patient characteristics

Case	Age/Sex	Location of DVT	Indication	Days to VT
1	75/M	L CIV	unsuccessful UK-F	14
2	65/M	L CIV	unsuccessful UK-F	10
3	42/M	L CFV	contraindication to UK-F	3
4	40/M	R CIV	phlegmasia cerulea dolens	2
5	31/F	R CFV	contraindication to UK-F	7
6	42/F	L CIV	Giant uterine myoma	3
7	43/M	L CFV	unsuccessful UK-F	10
8	61/F	R CIV	unsuccessful UK-F	10
9	53/M	L CIV	unsuccessful CDT	7
10	58/M	L CIV	unsuccessful CDT	13
11	58/M	L CIV	unsuccessful CDT	6

CIV: common iliac vein; CFV: common femoral vein; UK-F: urokinase-fibrinosis;  
 PCD: phlegmasia cerulea dolens; CDT: catheter-directed thrombolysis; Days to VT: time from onset to venous thrombectomy

Table 2 Operative results

Case	OR time	Previous IVC filter	A-V fistula	Complication/PTS	Follow-up
1	3 : 00	( - )	Vein	Lymphorrhoea/ ( - )	60
2	1 : 47	( - )	PTFE	( - ) / ( - )	56
3	1 : 00	( - )	( - )	( - ) / ( - )	52
4	1 : 50	( - )	Vein	( - ) / ( - )	49
5	1 : 00	( - )	( - )	( - ) / ( - )	42
6	3 : 40	Tempofilter™	( - )	( - ) / ( - )	38
7	1 : 33	( - )	( - )	( - ) / ( - )	34
8	2 : 15	Neuhaus Protect™	PTFE	( - ) / ( - )	29
9	1 : 30	Neuhaus Protect™	Vein	( - ) / ( - )	27
10	1 : 20	Gunter Tulip™	PTFE	( - ) / ( - )	19
11	2 : 30	Gunter Tulip™	PTFE	( - ) / ( - )	16

OR: operating time (hour : minute), A-V fistula: arteriovenous fistula, PTS: post-thrombotic syndrome, Follow-up: follow up time (month)

patients, and contraindications to urokinase administration in 2 patients (recent abdominal operation/hemorrhagic gastric ulcer).

The mean duration of surgery was 117 minutes. Lymphorrhoea was observed postoperatively in 1 patient but was resolved with resuturing. There were no major complications, such as PTE or bleeding. The patients were followed up for an average of 38.4 months and evaluated on their ability to perform activities of daily living at 1 year after surgery. All patients had satisfactory postoperative courses (**Table 2**), and there were no cases of lower limb laterality or postthrombotic syndrome (PTS). Postoperative venography confirmed that occlusion of the common iliac vein was completely resolved with fair collateral perfusion in all 11 patients (**Fig. 2**). The clinical

course has been extremely good, with no evidence of PTS, even in those followed up for 4 years or more.

### Discussion

Therapeutic options for acute DVT include conservative anticoagulation, thrombolytic therapy, and surgical treatment. Conservative therapy involves only heparin/warfarin and bed rest, so complete recovery is unusual. Thrombolytic therapy is contraindicated if there is a solid thrombus in the proximal pelvic veins. Furthermore, conservative anticoagulation and thrombolytic therapy are associated with a major risk of PTS. The use of aspiration and fibrinolysis therapy with a catheter<sup>2,3</sup> and endovascular stenting have recently been reported, and the midterm results are favorable<sup>4,5</sup>.

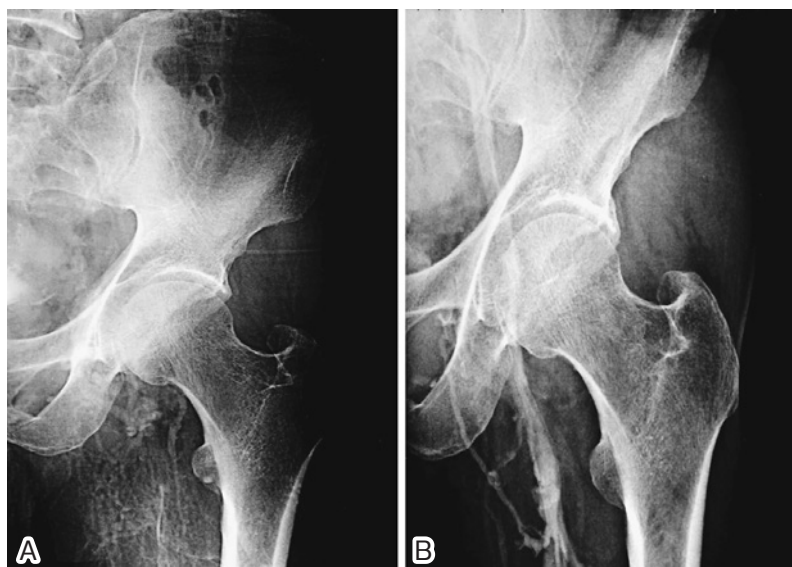


Fig. 2 A 40-year-old man with phlegmasia cerulea dolens. Complete occlusion of the common iliac vein was diagnosed with preoperative venography (A); improvement was noted within 1 week of operation (B).

However, the possibility of adverse effects caused by urokinase or tissue plasminogen activator has not been properly investigated, and long-term results have not been reported.

Surgical thrombectomy, as described by Heberer and van Dongen et al. in 1989, is widely performed in Europe<sup>1</sup>, but the technique is still not commonly employed in Japan, probably because of the risk of iatrogenic PTE in the perioperative period. In Germany, however, surgical thrombectomy is the preferred method for treating acute DVT and has been shown to prevent PTS. Each case must be evaluated individually, of course, but we believe that the advantages of this technique should be better known in Japan. We consider severe phlegmasia cerulea dolens to be an absolute indication for surgery, because if the venous lumen becomes completely occluded, the resulting disturbance in the arterial circulation can easily lead to gangrene. Here, time is the crucial factor for prognosis, and immediate operative intervention is indicated. In one of our patients, acute DVT was caused by a giant hysterymyoma compressing the iliac vein. We performed simultaneous hysterectomy and surgical thrombectomy and obtained a favorable outcome. In such cases, surgical thrombectomy has numerous advantages over catheter intervention and is clearly

Table 3 Contraindications to surgical thrombectomy

Absolute:

- Progressive malignancy
- Isolated venous thrombosis of the lower leg
- Intolerance to general anesthesia
- Risk of local wound-healing problems (e.g., folliculitis)

Relative:

- Duration of thrombosis (more than 14 days)
- Patient's age (older than 70 years)
- Clinically significant pulmonary embolism

indicated. Another advantage of this method is that it does not require preoperative placement of an inferior vena cava filter. In our series, there were 4 cases in which a filter had already been placed before surgery; in 2 of these cases, the filter was successfully removed. Heberer and van Dongen et al. have, however, suggested several contraindications for this surgical method, as summarized in **Table 3**.

According to Stiegler and Sunder-Plassmann, intraoperative pulmonary embolism, vascular perforation, postoperative bleeding, and recurrent thrombosis are the most significant complications of surgical thrombectomy<sup>1</sup>. They noted that the possibility of intraoperative pulmonary embolism must always be borne in mind and that this complication occurred in 3 of 234 operations in their

series. On the other hand, venous perforation is a rare complication, and postoperative bleeding usually occurs in the region of the skin incision and is minor. Nevertheless, diligent hemostasis and heparin dose control are necessary.

### Conclusions

We have employed a German method of surgical venous thrombectomy to operate on 11 Japanese patients with DVT and have obtained good results with no major complications. We believe that this surgical technique should be a standard treatment option in Japan, especially for patients with acute severe thrombosis or intrapelvic complications.

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