Deep venous thrombosis during pregnancy and after delivery: Indications for and results of thrombectomy

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Purpose: **Pregnancy and the puerperium are time periods of an increased risk for venous thromboembolism. An ideal treatment should lead to complete restoration of the venous lumen, elimination of the embolic source, and prevention of severe postphlebitic syndrome. Anticoagulation therapy with heparin or thrombectomy are treatment options. In the current literature, these options are discussed controversially.**
Methods: **From January 1982 to December 2001, 97 women underwent (93% transfemoral) thrombectomy and construction of an arteriovenous fistula (AVF) for deep venous thrombosis related to pregnancy. The clinical and coagulation parameters were evaluated. The AVF was ligated 3 to 6 months later. Follow-up with duplex ultrasound scan, photoplethysmography, and strain-gauge plethysmography was completed in 87 women.**
Results: **Surgery was performed without any maternal death or pulmonary embolization. A cesarean section was carried out during the same anesthesia in 11 cases. Thrombectomy was completed with construction of a temporary AVF in 90 patients (92.8%). One fetal death occurred in the recovery room for unknown reasons. In the early postoperative course, 16 patients (16.5%) underwent redo surgery for rethrombosis with or without the occlusion of the fistula. In 14 of these patients, the venous system remained patent thereafter. Fetal or neonatal death occurred in five cases 2 to 10 weeks after surgery, mainly because of abruption of the placenta probably from anticoagulation. Among 247 preoperatively occluded anatomic regions, 221 could be restored, and the secondary patency rate amounted to 89.5%. After a mean follow-up period of 6 years, 49 patients (56.3%) were seen without a postphlebitic syndrome, and only three patients (3.5%) had had a leg ulcer develop.**
Conclusion: **In experienced hands, venous thrombectomy is a safe method to prevent pulmonary embolism and postphlebitic syndrome in women during pregnancy and the puerperium. The frequency of a severe postphlebitic syndrome after our surgical approach is lower than the rates published for anticoagulation treatment alone. (J Vasc Surg 2003;37:528-32.)**

Pregnancy and the puerperium are periods of elevated risk for venous thromboembolism. The prepartum and peripartum incidence rates of deep venous thrombosis (DVT) are reported to be about 0.5 to 1.0 per 1000 live births.[1] One of 10 DVTs is complicated by pulmonary embolism (PE).[1,2] In addition to general risk factors for DVT, a family history of thromboembolic events, acquired or hereditary thrombophilia,[3] and pregnancy-associated factors, such as immobilization, hyperemesis gravidarum, amnion infection, placental abruption, hypertension, preeclampsia, and intrauterine growth retardation, have to be considered.[4-6]

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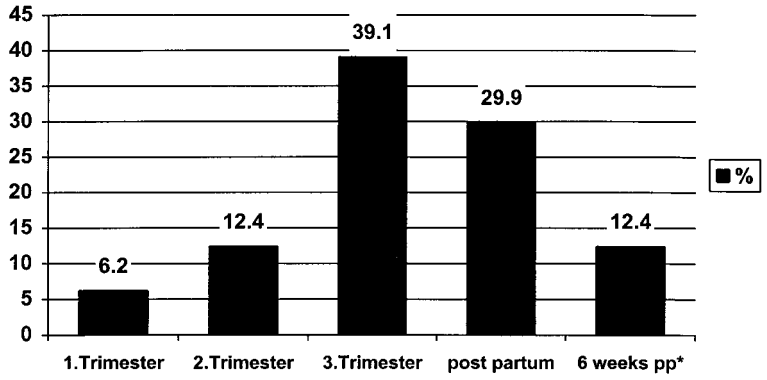
No consensus exists about the optimal treatment of patients with pregnancy-associated DVT involving the iliofemoral veins, with or without involvement of the inferior vena cava (IVC), which lead to PE in 10% of cases. In particular, the role of thrombectomy is discussed controversially. An ideal treatment should lead to a complete restoration of the venous lumen, elimination of the embolic source, prevention of severe postphlebitic syndrome (PPS), and preservation of the vein valve function. Anticoagulation therapy can prevent progression of thrombus and PE. Recanalization with heparin treatment has been demonstrated but is rare and unpredictable. It probably reflects a spontaneous lysis of the thrombus. Fibrinolysis seems to be the ideal treatment. Not only thrombi in the deep veins may be dissolved, but pulmonary emboli can be reached as well. However, fibrinolysis is associated with severe complications and contraindications.

PATIENT POPULATION AND METHODS

Six hundred sixty patients with DVT were treated with venous thrombectomy in our department during the last 18 years, among them 97 pregnant or puerperal women. The overall average age was 41.3 years (range, 14 to 77 years); the average age of the subgroup (n = 97) was only 22.0 years (range, 17 to 41 years).



Thrombotic events during pregnancy and after delivery. *pp,* Postpartum.

A retrospective review of all patient files from 1982 to 1996 and a prospective study from April 1996 to December 2001 were performed to collect all data from patients with thromboembolic events during pregnancy and after delivery. Medical history, pregnancy-related complications, and hereditary and acquired coagulation risk factors were reported.

Most of the thromboembolic events was diagnosed in the third trimester, with 39.1%, and in the early postpartum period, with 29.9% (Figure). The onset of symptoms was within 10 days before surgery in nearly 75% and in more than 10 days in 15%, and in 10% of the patients, no information was available about the onset. Twelve percent had symptoms or a positive computed tomographic (CT) scan of PE previous to admission to our department.

We assessed the anatomy of DVT in each woman selected for surgery by describing the extension into various anatomic regions with phlebography and duplex scan results. Additional CT scans were performed to exclude an involvement of the IVC in 20 patients. In 19 patients (19.6%), the thrombosis extended from the IVC, and in 78 patients (80.4%), from the iliac veins to distal regions (Table I). On average, patients had more than 2.5 regions (total, 247 regions) affected. In all cases, a thrombectomy was performed and, except for seven women, completed with the construction of an arteriovenous fistula (AVF), usually in the groin. The fistula was constructed with the femoral artery or popliteal artery and a side branch of the greater saphenous vein, but not below the tibiofibular trunk to achieve sufficient flow.

The most frequent risk factor among the patient group was a pregnancy-related immobilization in 49 individuals (50.5%), followed by a familial history of DVT in 12 patients (12.4%) and hereditary risk factors (factor V Leiden) in five patients (5.2%). Nearly all patients were referred to our department from outside hospitals. In some instances, a primary therapy had already been initiated. Six percent (n = 6) had already undergone unsuccessful fibrinolysis and 2.1% (n = 2) unsuccessful thrombectomy before admission to our department.

Table I. Anatomical involvement

Anatomical regions	*No.*
IVC	3 (3.1%)
IVC + IV	3 (3.1%)
IVC + IV + FV	4 (4.1%)
IVC + IV + FV + PV	1 (1.0%)
IVC + IV + FV + PV + CV	8 (8.3%)
IV	12 (12.4%)
IV + FV	46 (47.4%)
IV + FV + PV	10 (10.3%)
IV + FV + PV + CV	10 (10.3%)
Total	97 (100%)

IV, Iliac vein; *FV,* femoral vein; *PV,* popliteal vein; *CV,* crural vein.

Table II. Localization of AVF

Localization	*No.*
Inguinal	
Unilateral	70 (75.2%)
Bilateral	9 (9.3%)
Adductor channel	6 (6.2%)
Popliteal	5 (5.2%)
No fistula	7 (7.1%)

An experienced obstetrician was present at the time of thrombectomy, during which the fetal heart rate was monitored continuously. In the prospective part of the study, all pregnant women scheduled for surgery before 34 weeks of gestation received induction of lung maturity.

The operative technique included interruption of the blood flow exclusively with vessel loops in a tourniquet fashion and longitudinal venotomy (because transverse venotomy does not allow to inspect and to thrombectomize all adjacent veins). To avoid PE, a Fogarty catheter (8F to 14F) was placed into the IVC before a second catheter was used for thrombectomy. If the thrombosis extended into the IVC, the protective catheter was inserted through the greater saphenous vein from the contralateral

Table III. Intrauterine or perinatal death after thrombectomy during long-term anticoagulation therapy

	Gestation week	*Treatment*	*Death after*	*Cause*
Case 1+2 (gemini)	27 wks	Previous lysis + thrombectomy	2 wks	Placental abruption
Case 3	24 wks	Thrombectomy	10 wks	Placental abruption
Case 4	25 wks	Thrombectomy	10 wks	Imminent demise and placental abruption
Case 5	30 wks	Thrombectomy	4 wks	Imminent demise and placental abruption

Table IV. Long-term results: PPS after mean observation period of 6 years (range, 0.5 to 16.5 years)

	CEAP class	*No.*
No PPS	0	49 (56.3%)
Mild PPS	1-2	31 (35.6%)
Severe PPS	3-4	4 (4.6%)
Venous ulcer	5-6	3 (3.5%)

side. Manual and rubber band compression thrombectomy was performed for distal thrombosis. Before discharge, every patient was examined with duplex or CT scan. An inguinal incision was used in 90 patients (92.8%), a transperitoneal-inguinal incision in three patients (3.1%), and a laparotomy exclusively in four patients (4.1%). A simultaneous cesarean section was scheduled in 11 women (11.3%). In one patient, an inflammatory ovarian vein had to be resected. The AVF was closed within 6 months after thrombectomy. Anticoagulation therapy with low–molecular weight heparin was administered in women during pregnancy until delivery and then switched to warfarin sodium. In women with DVT after delivery, we started warfarin sodium therapy at the first day after surgery. Anticoagulation therapy ended 3 months after AVF closure.

All patients were invited for a follow-up examination after the study protocol. Duplex scan, photoplethysmography, and strain-gauge plethysmography were performed after 6 weeks, every 3 months, and yearly to check the patency of the deep veins and the valve function. Blood samples were taken to determine factor V Leiden (G1691A), prothrombin mutation (G20210A), methyltetrahydrofolate reductase polymorphism (G677T), reduced levels of antithrombin III, protein S, and protein C.

RESULTS

No patient died during surgery. Moreover, no pulmonary embolization was detected with pulmonary artery catheter, which was used routinely. One fetus died in the recovery room for unknown reasons. In most of our patients (84.5%), the AVF was constructed in the groin (Table II). Seven patients received no AVF because the DVT was estimated to be not older than 5 days and limited to only one anatomic region. No rethrombosis occurred in these cases.

In 16 patients (16.5%), rethrombosis occurred before scheduled discharge. All of these 16 patients underwent successful reoperation, with 14 complete and two partial restorations of the lumen. A small PE in three patients (3.1%) and a heparin-induced thrombocytopenia type II in four patients (4.1%) were diagnosed in the postoperative period. Three patients (3.1%) had pneumonia develop after preoperative PE. The postoperative duplex scan or the CT scan showed a complete restoration of the lumen in 88 patients (90.7%). Of 247 anatomic regions occluded before surgery, patency was restored in 221 (secondary patency rate, 89.5%).

Five neonates or fetuses of women with continuing pregnancy after thrombectomy died in utero or perinatally 2 to 10 weeks after surgery. The main reason was an abruption of the placenta probably from anticoagulation therapy (Table III).

Eighty-seven of 97 patients (89.7%) were examined routinely after 6 weeks, 3 months, and 6 months and then once a year for follow-up in our outpatient clinic. The mean follow-up period was 70.5 months.

Forty-nine women (56.3%) had no symptoms of PPS, 31 (35.6%) showed only mild symptoms, and four patients (4.6%) had severe PPS. Ulceration occurred in three patients (3.5%) after surgery within 24 months (Table IV).

During the observation period, a second episode of DVT occurred in 10 patients (11.5%) and DVT combined with PE in one woman. In the case with DVT and PE, surgery was performed successfully again. The other patients underwent anticoagulation therapy because the DVT was limited to the veins below the inguinal ligament.

Table V summarizes the risk factors in our patients compared with an age-matched group of healthy volunteers. The highest relative risk was found for prothrombin mutation (odds ratio, 11.4) followed by factor V Leiden (odds ratio, 7.7). Risk estimations for deficiencies of antithrombin, protein C, and protein S were valid only for mild deficiencies.

DISCUSSION

Heparin is the conventional treatment for DVT during pregnancy, but it can cause complications.[6] Bleeding, spontaneous bone fractures, and heparin-induced thrombocytopenia type II are the major complications of anticoagulation therapy.[7] Rutherford and Phelan[8] reported a 5% to 30% maternal complication rate for anticoagulation treatment, and Ginsberg[9] reported a 2.6% fetal mortality

Table V. Prevalence and relative risk of hereditary coagulation defects in women with venous thromboembolism as compared with healthy women

Risk factors	*Patients (with defect/total no.)*	*Controls (with defect/total no.)*	P *value*	*Relative risk (95% CI*)*
Factor V Leiden	37.3 (25/67)	7.2 (20/279)	<.001	7.7 (3.9-15.1)
G20210A prothrombin-gene mutation	17.9 (12/67)	1.9 (5/266)	<.001	11.4 (3.9-33.6)
677TT MTHFR genotype	9.0 (6/67)	8.7 (23/266)	.936	1.0 (0.4-2.7)
Antithrombin deficiency (< 85% activity)*	3.8 (2/53)	1.3 (2/154)	.271	3.0 (0.4-21.7)
Protein C deficiency (<70% activity)	6.5 (4/62)	3.3 (9/274)	.27	2.0 (0.6-6.8)
Protein S deficiency (< 60% activity)†	5.9 (2/34)	5.0 (7/139)	1.0	1.2 (0.2-5.9)

*After exclusion of women taking heparin or oral contraceptives.
†Women who were taking oral contraceptive and were carriers of factor V Leiden were excluded from analysis.

rate. In our patient group, the surgery-related fetal mortality rate was 1.8% (1/53). During long-term anticoagulation therapy after thrombectomy, five fetal deaths occurred, mainly caused by abruption of the placenta or imminent demise. Heparin treatment can most probably avoid thrombus progression and reduce the risk for PE but does not restore the vascular lumen.

Theoretically, fibrinolysis appears favorably because not only thrombi in the deep veins may be dissolved but pulmonary emboli can be reached as well. However, the risk of severe bleeding precludes its use during pregnancy.[10]

Consequently, surgical restoration of the deep venous system is an attractive alternative. There are two key points to success (ie, the special surgical technique and the AVF). The technique of venous thrombectomy is different from arterial thrombectomy as described before.[11] The fistula increases blood velocity through the thrombectomized veins and causes an elevation of venous pressure and continuous flow even at times of maximal inspiration. In our opinion, the anatomic approach, the exclusive use of vessel loops, and the location of the AVF are contributing elements to a favorable outcome. In our study, no pregnant women died and no intraoperative PE occurred. This shows the safety of surgical treatment of DVT in pregnancy.[11] In the literature, the frequency of PPS after anticoagulation therapy during pregnancy is quoted between 60% and 78%. After surgical treatment and consecutive anticoagulation therapy, the frequency of PPS is approximately 40% (Table VI).

Thromboembolic events are major causes of maternal mortality.[12] It is important to identify patients at risk. Knowledge about genetic factors for thrombosis allows administration of a risk- adapted treatment for prevention of rethrombosis and recurrent PE.[3,13-15] Anticoagulation therapy with heparin followed by warfarin sodium can usually be terminated after 6 to 12 months if there is no residual indication for long-term anticoagulation. In these patients at high risk, heparin prophylaxis should be instituted during further episodes predisposing to thrombosis (eg, immobilization, surgery, another pregnancy).

Table VI. Long-term results in literature

Author	*Published*	*Therapy*	*Follow-up (y)*	*No.*	*CEAP C1-6*	*CEAP C5-6*
Lindhagen	1986	A	7	23	65%	?
Berqvist	1990	A	11	104	78%	4%
Törngren	1996	A	9	25	66%	4%
		S	9	30	47%	0
Rosfors	2001	A	16	25	60%	0
Own study	Present paper	S	6	97	40%	3%

Therapy: *S,* Surgery; *A,* anticoagulation.

In summary, venous thrombectomy is a safe method to prevent PE and recurrent thromboembolic events, even in women during pregnancy and after delivery. According to our criteria, surgical removal of the thrombi was indicated in patients with massive painful blue edema, DVT extending above the inguinal ligament, proximal thrombi not adherent to the vein wall as documented with duplex scan or CT scan studies, previous PE, and the involvement of the IVC and bilateral iliac veins. Maternal and fetal complications are comparable with those with heparin treatment. Thrombectomy in combination with a temporary AVF can restore venous lumen completely (in our patients, 90.7%) and safely in patients with massive DVT, thereby reducing the risk of PPS (in our patients, C3-6, 8.1%). However, this delicate surgery should remain in the hands of experts specialized in surgery of the deep veins. We need further studies to compare the results of thrombectomy (regarding PE, PPS, patency, and recurrent DVT) with other treatment.

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