American College of Radiology
ACR Appropriateness Criteria®

Radiologic Management of Iliofemoral Venous Thrombosis

Variant: 1 Acute iliofemoral DVT with mild symptoms less than 14 days, otherwise healthy.

Procedure	Appropriateness Category
Anticoagulation alone	Usually Appropriate
Graded compression stocking therapy	May Be Appropriate
CDT/PMT with or without stent placement	Usually Not Appropriate
Surgical thrombectomy techniques	Usually Not Appropriate

Variant: 2 Acute iliofemoral DVT with moderate to severe symptoms present for less than 14 days, otherwise healthy.

Procedure	Appropriateness Category
CDT/PMT with or without stent placement	Usually Appropriate
Anticoagulation alone	Usually Appropriate
Surgical thrombectomy techniques	May Be Appropriate

Variant: 3 Acute femoropopliteal DVT with mild to moderate symptoms present for less than 14 days, otherwise healthy.

Procedure	Appropriateness Category
Anticoagulation alone	Usually Appropriate
Graded compression stocking therapy	May Be Appropriate
CDT/PMT	Usually Not Appropriate

Variant: 4 Acute iliofemoral DVT and symptoms less than 14 days. Cross-sectional imaging consistent with May-Thurner syndrome.

Procedure	Appropriateness Category
CDT/PMT with or without stent placement	Usually Appropriate
Anticoagulation alone	May Be Appropriate
Hybrid surgical thrombectomy with stenting	May Be Appropriate

Variant: 5 Acute iliofemoral DVT and limb-threatening ischemia (phlegmasia cerulea dolens).

Procedure	Appropriateness Category
CDT/PMT with or without stent placement	Usually Appropriate
Surgical thrombectomy with or without stent placement	Usually Appropriate
Systemic thrombolysis	May Be Appropriate
Anticoagulation alone	Usually Not Appropriate

Variant: 6 Iliofemoral DVT with persistent moderate symptoms at least 3 months after initial treatment with anticoagulation alone.

Procedure	Appropriateness Category
Anticoagulation alone	May Be Appropriate

CDT/PMT with or without stent placement	May Be Appropriate
Graded compression stocking therapy	May Be Appropriate
Surgical thrombectomy with or without stent placement	May Be Appropriate (Disagreement)

Variant: 7 Acute iliofemoral DVT in a pregnant patient with moderate to severe symptoms.

Procedure	Appropriateness Category
Anticoagulation alone	Usually Appropriate
CDT/PMT with or without stent placement	May Be Appropriate
Graded compression stocking therapy	May Be Appropriate
Surgical thrombectomy with or without stent placement	May Be Appropriate

Panel Members

Khashayar Farsad, MD, PhD[a], Baljendra S. Kapoor, MD[b], Nicholas Fidelman, MD[c], Thomas R. Cain, MD[d], Drew M. Caplin, MD[e], Jens Eldrup-Jorgensen, MD[f], Amit Gupta, MD[g], Mikhail C.S.S. Higgins, MD, MPH[h], Eric J. Hohenwalter, MD[i], Margaret H. Lee, MD[j], Joseph J. McBride, MD[k], Jeet Minocha, MD[l], Paul J. Rochon, MD[m], Patrick D. Sutphin, MD, PhD[n], Jonathan M. Lorenz, MD[o]

Summary of Literature Review

Introduction/Background

Venous thromboembolic disease (VTE), including deep vein thrombosis (DVT) and pulmonary embolism (PE), carries significant morbidity and economic burden with an estimated annual $7 to 10 billion in health expenditures and 375,000 to 425,000 incidence of new cases per year in the United States alone [1]. In addition to the risks of fatal PE, VTE is associated with high rates of recurrent DVT, post-thrombotic syndrome (PTS), and chronic PE with significant impacts on patient quality of life [1]. Management of VTE is multidisciplinary with potential involvement of providers from specialties and subspecialties including internal medicine, family practice, hematology/oncology, pulmonology, cardiology, vascular surgery, and interventional radiology. Iliofemoral venous thrombosis carries high risk for PE, recurrent DVT, and PTS [2] with reported estimates of PTS ranging from 30% to 71% of those with iliofemoral DVT [2,3]. Goals for management include preventing morbidity from venous occlusive disease as well as preventing morbidity and mortality from PE.

Overview of diagnostic and therapeutic options

In general, the standard of care for iliofemoral VTE is anticoagulation in patients without a contraindication [4]. Depending on the circumstance, cross-sectional imaging may be appropriate to assess for an underlying obstructive cause, such as a venous compression syndrome or mass. In addition, ultrasound or CT may be helpful to differentiate chronic from acute DVT [2]. Patients with an underlying anatomic compression syndrome (eg, May-Thurner syndrome) amenable to intervention or surgery generally have this addressed in addition to receiving anticoagulation therapy. There may be differences in the anticoagulation regimens prescribed for patients, depending on the clinical scenario (eg, cancer-related VTE, pregnancy-related VTE, or VTE in the setting of renal impairment). Although in some instances, there may be a role for more aggressive therapy with catheter-based interventions or surgery in addition to anticoagulation,

anticoagulation alone remains the pillar of care.

Discussion of Procedures by Variant

Variant 1: Acute iliofemoral DVT with mild symptoms less than 14 days, otherwise healthy.

Variant 1: Acute iliofemoral DVT with mild symptoms less than 14 days, otherwise healthy.

A. Anticoagulation alone

The first-line therapy for acute iliofemoral DVT with mild symptoms is anticoagulation [5]. Therapy is indicated, even in the absence of symptoms, to prevent recurrent VTE. Duration of anticoagulation is generally at least 3 months, with indefinite anticoagulation indicated for those with unprovoked DVT and otherwise without contraindication, such as a significant bleeding risk with anticoagulation [5]. Those with a contraindication to anticoagulation may be considered for inferior vena cava filter placement [6,7].

Variant 1: Acute iliofemoral DVT with mild symptoms less than 14 days, otherwise healthy.

B. CDT/PMT with or without stent placement

Two large prospective randomized controlled trials, The Norwegian-based Catheter-directed Venous Thrombolysis (CaVenT) trial and the United States–based Acute Venous Thrombosis: Thrombus Removal With Adjunctive Catheter-Directed Thrombolysis (ATTRACT) trial attempted to address whether improved early venous patency results in reduced PTS with rigorous trial designs comparing catheter-based therapies with thrombolysis and anticoagulation to standard-of-care anticoagulation alone. Five-year outcomes from the CaVenT trial demonstrated improved venous disease grading scores with reduction in PTS in those treated with catheter-directed thrombolysis (CDT) compared with anticoagulation alone (43% versus 71%, P <.0001) [3]. Despite this, the two arms did not differ in patient quality-of-life measures. The larger ATTRACT trial showed no overall difference in PTS outcomes between patients randomized to CDT versus anticoagulation alone (47% versus 48%, P =.56) despite significant decreases in PTS severity scores as measured by the Villalta scale and Venous Clinical Severity Score (VCSS) [8]. The incidence of major bleeding was greater in those treated with CDT (1.7% versus 0.03%, P =.049). Thus, based on these recent prospective randomized trials, there is currently no role for catheter-based therapies in this cohort with mild symptoms to reduce PTS [3,8].

Variant 1: Acute iliofemoral DVT with mild symptoms less than 14 days, otherwise healthy.

C. Graded compression stocking therapy

Graded compression therapy with stockings has traditionally been recommended to address venous stasis changes and potentially prevent PTS; however, several recent randomized trials have found no specific benefit to compression therapy in preventing PTS [9-14]. Use of graded compression stockings in conjunction with additional measures, such as frequent leg elevation, may be recommended in addition to anticoagulation on an individualized basis for patient comfort and symptom management.

Variant 1: Acute iliofemoral DVT with mild symptoms less than 14 days, otherwise healthy.

D. Surgical thrombectomy techniques

The Society of Vascular Surgery guidelines generally recommend catheter-based therapies over open surgery for VTE and, as such, surgical thrombectomy would not be recommended for mildly symptomatic or asymptomatic iliofemoral DVT considering the risk-to-benefit ratio [15].

Variant 2: Acute iliofemoral DVT with moderate to severe symptoms present for less than 14

days, otherwise healthy.

Acute proximal DVT, defined as involvement of the iliac and upper femoral venous system, carries a high risk of PE [2,5]. Morbidity associated with proximal iliofemoral DVT includes recurrent DVT or PE and PTS, which consists of lower-extremity pain, swelling, venous claudication, and venous stasis, potentially leading to venous ulceration. For these reasons, treatment for acute proximal iliofemoral DVT is indicated [5].

Variant 2: Acute iliofemoral DVT with moderate to severe symptoms present for less than 14 days, otherwise healthy.

A. Anticoagulation alone

Anticoagulation with heparin, vitamin K antagonist, or direct oral anticoagulants are recommended as a first-line therapy, with newer guidelines suggesting preference for the direct oral anticoagulants in patients without cancer because of a reduced bleeding risk and better patient convenience [5]. Duration of anticoagulation generally lasts for at least 3 months, with indications for indefinite anticoagulation remaining for those with unprovoked DVT and otherwise without contraindication to or significant bleeding risk with anticoagulation [5].

Variant 2: Acute iliofemoral DVT with moderate to severe symptoms present for less than 14 days, otherwise healthy.

B. CDT/PMT with or without stent placement

There has been considerable interest in more aggressive measures to quickly remove thrombus burden in acute iliofemoral DVT to minimize valvular damage that can lead to PTS, termed the "open vein" hypothesis. Studies have consistently demonstrated improved early venous patency rates in patients undergoing CDT or pharmacomechanical thrombectomy (PMT) with angioplasty or stenting of obstructive lesions relative to anticoagulation alone [16]. Two large prospective randomized controlled trials, the CaVenT trial and the ATTRACT trial, attempted to address whether improved early venous patency resulted in reduced PTS with rigorous trial designs comparing catheter-based therapies with thrombolysis and anticoagulation to standard-of-care anticoagulation alone. Five-year outcomes from the CaVenT trial demonstrated improved venous disease grading scores with reduction in PTS in those treated with CDT compared with anticoagulation alone (43% versus 71%, *P* <.0001) [3]. Despite this, the two arms did not differ in patient quality-of-life measures. The larger ATTRACT trial showed no overall difference in PTS outcomes between patients randomized to CDT versus anticoagulation alone (47% versus 48%, *P* =.56) despite significant decreases in PTS severity scores as measured by the Villalta scale and VCSS [8]. The incidence of major bleeding was greater in those treated with CDT (1.7% versus 0.03%, *P* =.049), with no reported fatal intracranial hemorrhage. A subgroup analysis of 391 prospectively stratified patients within the ATTRACT trial who had acute DVT involving iliac and/or common femoral veins (ie, the subgroup with more proximal DVT involving larger central veins) found a benefit to additional CDT in this cohort relative to anticoagulation alone, particularly in those <65 years of age [17]. The benefits included significant improved early reduction in leg pain and swelling (*P* <.01), reduced PTS severity through 24 months (*P* <.01), and a decreased proportion of patients with moderate or severe PTS (Villalta scale >10 or ulcer: 18% versus 28%; relative risk [RR] 0.65, *P* =.021; Villalta scale >15 or ulcer: 8.7% versus 15%; RR 0.57, *P* =.048; VCSS >8: 6.6% versus 14%; RR 0.46, *P* =.013) despite no differences in the overall incidence of PTS at 2 years. Furthermore, significant improvement in venous-specific quality-of-life scores were noted in the cohort receiving CDT compared with anticoagulation alone (*P* =.029), despite no difference in generic quality of life (*P* >.20). Moreover, in this subgroup, additional CDT did not result in increased major bleeding relative to anticoagulation alone (1.5% versus 0.5%, *P* =.32). Part of the

challenge in interpreting the apparent discrepancy between lack of measurable change in generic quality-of-life assessments, despite decreases in severity or incidence of PTS according to venous grading scales in these two studies, may rest in the relatively broad range of quality-of -life perception that has been reported for VTE [18].

Percutaneous mechanical thrombectomy alone has also been reported in a small series for reduction of thrombus burden and symptomatic improvement [19]. For patients who cannot receive thrombolytics and who have severe symptoms, thrombectomy strategies in addition to anticoagulation may be reasonable, although there is no relevant literature regarding the durability of these treatments and their long-term outcomes. Thus, optimal patient selection for more aggressive strategies versus anticoagulation alone may need further refinement to identify those who will benefit most. At present, the best available data suggest CDT in conjunction with anticoagulation should be reserved for select cases of proximal DVT in severely symptomatic patients with low bleeding risk [3,8,17].

Variant 2: Acute iliofemoral DVT with moderate to severe symptoms present for less than 14 days, otherwise healthy.

C. Surgical thrombectomy techniques

Although the Society of Vascular Surgery guidelines recommend catheter-based therapies over open surgery for VTE [15], surgical thrombectomy with or without arteriovenous fistula creation and hybrid operative thrombectomy with iliac vein stenting has been explored as an alternative intervention for acute DVT. Hybrid techniques with thrombectomy and stenting have largely replaced adjunctive arteriovenous fistula creation. Available studies include case series, case control trials, and a few prospective trials showing improved patient outcomes with operative techniques but no large rigorous head-to-head controlled trials assessing the performance of operative strategy to catheter-based therapies or anticoagulation alone [20-23]. For patients who cannot receive thrombolytics and who have severe symptoms, thrombectomy strategies may be reasonable, although there is no relevant literature regarding the durability of these treatments and their long-term outcomes.

Variant 3: Acute femoropopliteal DVT with mild to moderate symptoms present for less than 14 days, otherwise healthy.

Variant 3: Acute femoropopliteal DVT with mild to moderate symptoms present for less than 14 days, otherwise healthy.

A. Anticoagulation alone

Femoropopliteal DVT carries a risk for proximal extension and PE and is therefore also treated with anticoagulation as a first-line therapy. Duration of anticoagulation is generally at least 3 months, with indications for indefinite anticoagulation remaining for those with unprovoked DVT and otherwise without contraindication to or significant bleeding risk with anticoagulation [5].

Variant 3: Acute femoropopliteal DVT with mild to moderate symptoms present for less than 14 days, otherwise healthy.

B. CDT/PMT

Despite the known risks of PTS in this cohort, the best prospective evidence to date with the ATTRACT trial has demonstrated no improvement in PTS at 2 years with more aggressive CDT over anticoagulation alone. There is no relevant literature regarding use of percutaneous mechanical thrombectomy or surgical thrombectomy for those who cannot receive anticoagulation in this

setting; however, extrapolation from the ATTRACT trial suggests this would not be of clinical benefit [8,15].

Variant 3: Acute femoropopliteal DVT with mild to moderate symptoms present for less than 14 days, otherwise healthy.

C. Graded compression stocking therapy

Graded compression therapy with stockings has traditionally been recommended to address venous stasis changes and potentially prevent PTS; however, several recent randomized trials have found no specific benefit to compression therapy in preventing PTS [9-14]. Use of graded compression stockings in conjunction with additional measures, such as leg elevation, may be recommended in addition to anticoagulation on an individualized basis for patient comfort and symptom management.

Variant 4: Acute iliofemoral DVT and symptoms less than 14 days. Cross-sectional imaging consistent with May-Thurner syndrome.

Variant 4: Acute iliofemoral DVT and symptoms less than 14 days. Cross-sectional imaging consistent with May-Thurner syndrome.

A. Anticoagulation alone

Anticoagulation is generally a first-line therapy for acute iliofemoral DVT [5]. Presentation of acute left-sided DVT, particularly in otherwise young and healthy patients, should raise suspicion for a compression syndrome as there is a relatively higher incidence of iliac vein compression in this cohort (ie, May-Thurner Syndrome). As this finding may be underdiagnosed, many patients with iliofemoral DVT and an obstructive iliac vein lesion may be treated with anticoagulation alone. Recurrent VTE in the affected limb has been observed more frequently with anticoagulation alone compared with those who underwent additional treatment with thrombectomy and iliac vein stenting [24-26]. Despite a general consensus to treat iliac vein obstructive lesions with stents in addition to anticoagulation, there is no relevant literature rigorously testing this practice against anticoagulation alone in prospective randomized controlled trials.

Variant 4: Acute iliofemoral DVT and symptoms less than 14 days. Cross-sectional imaging consistent with May-Thurner syndrome.

B. CDT/PMT with or without stent placement

Presentation of acute left-sided DVT, particularly in otherwise young and healthy patients, should raise suspicion for a compression syndrome as there is a relatively higher incidence of iliac vein compression in this cohort (ie, May-Thurner Syndrome). Because of the underlying anatomic compression, additional measures, including balloon angioplasty with stenting of the compressive lesion, has been described with reported benefit in a small retrospective series [27-29]. Although there is no relevant literature rigorously testing this practice against anticoagulation alone in prospective randomized controlled trials, the general consensus is to treat iliac vein obstructive lesions with stents in addition to anticoagulation as recurrent VTE in the affected limb has been observed more frequently with anticoagulation alone [24-26].

Variant 4: Acute iliofemoral DVT and symptoms less than 14 days. Cross-sectional imaging consistent with May-Thurner syndrome.

C. Hybrid surgical thrombectomy with stenting

Surgical thrombectomy/endovenectomy and iliac vein stenting have also been described in the setting of obstructive iliofemoral DVT with reported benefit in small retrospective series [23,30]; however, there is no relevant literature comparing this therapy against anticoagulation alone or

anticoagulation with catheter-based therapy in prospective randomized controlled trials.

Variant 5: Acute iliofemoral DVT and limb-threatening ischemia (phlegmasia cerulea dolens).

Variant 5: Acute iliofemoral DVT and limb-threatening ischemia (phlegmasia cerulea dolens). A. Anticoagulation alone

Rarely, acute iliofemoral DVT can present as a potentially life- and limb-threatening emergency known as phlegmasia cerulea dolens. Typically, a faster course of action is required above anticoagulation alone to prevent venous gangrene and potentially death.

Variant 5: Acute iliofemoral DVT and limb-threatening ischemia (phlegmasia cerulea dolens). B. CDT/PMT with or without stent placement

Depending on the state of the threatened limb, techniques for rapid thrombus resolution have included surgical thrombectomy, percutaneous mechanical thrombectomy, and CDT [15,21,31,32]. Because of the rare nature of the condition, there is no relevant literature comparing outcomes between medical, catheter-based, or surgical therapies with prospective randomized controlled trials.

Variant 5: Acute iliofemoral DVT and limb-threatening ischemia (phlegmasia cerulea dolens). C. Surgical thrombectomy with or without stent placement

Depending on the state of the threatened limb, techniques for rapid thrombus resolution have included surgical thrombectomy, percutaneous mechanical thrombectomy, and CDT [15,21,31,32]. Because of the rare nature of the condition, there is no relevant literature comparing outcomes between medical, catheter-based, or surgical therapies with prospective randomized controlled trials.

Variant 5: Acute iliofemoral DVT and limb-threatening ischemia (phlegmasia cerulea dolens). D. Systemic thrombolysis

Systemic intravenous delivery of thrombolytic medication has been performed in the past for severe symptoms of DVT [16]. Because of the risks of potential bleeding complications, systemic thrombolysis has largely been supplanted with catheter and surgical options that provide rapid treatment with lower risks of bleeding. However, because of the rare nature of the condition, there is no relevant literature directly comparing outcomes between medical, catheter-based, or surgical therapies with prospective randomized controlled trials.

Variant 6: Iliofemoral DVT with persistent moderate symptoms at least 3 months after initial treatment with anticoagulation alone.

Variant 6: Iliofemoral DVT with persistent moderate symptoms at least 3 months after initial treatment with anticoagulation alone.
A. Anticoagulation alone

The best way to address chronic DVT to improve symptoms of PTS remains controversial. Anticoagulation is indicated if imaging demonstrates recurrent VTE or for patients with unprovoked DVT to prevent recurrent VTE [5]. In the absence of new DVT, symptoms may reflect chronic PTS. Interventional catheter-based techniques and surgery have been described to address chronic symptoms. There is no relevant literature assessing the performance of these different procedures in prospective randomized controlled trials.

Variant 6: Iliofemoral DVT with persistent moderate symptoms at least 3 months after initial treatment with anticoagulation alone.

B. CDT/PMT with or without stent placement

Beneficial outcomes have been reported with chronic DVT symptoms in small retrospective uncontrolled series with venous recanalization and improvement of outflow with balloon angioplasty and stenting [33-36]. A post hoc subgroup analysis of patients randomized to CDT alone versus CDT with adjunctive balloon angioplasty showed beneficial outcomes with additional balloon angioplasty on symptomatic venous scales with patients presenting with subacute, rather than acute, DVT [37]. A trial examining the efficacy of endovascular intervention for chronic DVT with stenting of occluded segments with or without adjunctive endovenous ablation for saphenous vein reflux (Chronic Venous Thrombosis: Relief With Adjunctive Catheter-Directed Therapy, NCT03250247: https://clinicaltrials.gov/ct2/show/NCT03250247) is currently underway.

Variant 6: Iliofemoral DVT with persistent moderate symptoms at least 3 months after initial treatment with anticoagulation alone.

C. Graded compression stocking therapy

Graded compression therapy with stockings is commonly employed to manage venous stasis symptoms, although recent series have shown it has no proven benefit in preventing PTS [9-14]. Use of graded compression stockings in conjunction with additional measures, such as leg elevation, may be recommended on an individualized basis for patient comfort and symptom management.

Variant 6: Iliofemoral DVT with persistent moderate symptoms at least 3 months after initial treatment with anticoagulation alone.

D. Surgical thrombectomy with or without stent placement

There is no relevant literature examining the efficacy of surgical thrombectomy compared with control groups in prospective randomized trials. Observational case series demonstrating symptomatic improvement after surgical endovenectomy with iliac vein stenting [38,39], and with saphenofemoral venous bypass [40], have been described.

Variant 7: Acute iliofemoral DVT in a pregnant patient with moderate to severe symptoms.

Variant 7: Acute iliofemoral DVT in a pregnant patient with moderate to severe symptoms.

A. Anticoagulation alone

VTE can complicate pregnancy, and first-line therapy is anticoagulation with low molecular weight heparin because of the lack of placental transgression [5]. There is no relevant literature providing guidance for duration of anticoagulation therapy, and individual patient management will factor risks of recurrent VTE and plans for future pregnancy. Although more aggressive thrombus removal strategies have been employed for pregnancy-related DVT, at present there is no relevant literature suggesting improvement in outcomes with use of these more aggressive therapies over anticoagulation alone in prospective randomized controlled trials. The available data suggest optimal management to be anticoagulation with low molecular weight heparin for iliofemoral DVT with mild to moderate symptoms and, potentially, catheter-based therapy in the second or third trimester for severe symptoms unrelenting after a trial of anticoagulation [41-43]. Surgical thrombectomy and arteriovenous fistula creation may be considered in the second or third trimester as well for severe refractory cases and to avoid radiation [21,44]. Depending on circumstances, optimal management could include anticoagulation until term, followed by CDT or thrombectomy if indicated for severe symptomatic DVT in the postpartum period [21,42,43].

Variant 7: Acute iliofemoral DVT in a pregnant patient with moderate to severe symptoms.

B. CDT/PMT with or without stent placement

There is no relevant literature defining the benefit of catheter-based therapies for pregnancy-related iliofemoral DVT compared with anticoagulation alone in prospective randomized controlled trials. Case series of patients presenting with severe symptoms treated with CDT including thrombolysis, percutaneous mechanical thrombectomy, angioplasty, and stenting have shown symptomatic efficacy and safety with respect to fetal and maternal health [42,44]. The issue of radiation exposure becomes critical, particularly in the first trimester, as reported radiation doses to the fetus have been estimated at 175 to 245 mGy, approximately 6- to 10-fold greater than environmental exposure [42]. Thus, local multidisciplinary ethics board discussion surrounding CDT in the first trimester is paramount. Second trimester CDT may be considered with severe symptoms refractory to anticoagulation, using shielding and principles of ALARA [42]. Depending on circumstances, optimal management could include anticoagulation until term, followed by CDT or thrombectomy if indicated for severe symptomatic DVT in the postpartum period [21,42,43].

Variant 7: Acute iliofemoral DVT in a pregnant patient with moderate to severe symptoms. C. Graded compression stocking therapy

Graded compression therapy with stockings has traditionally been recommended to address venous stasis changes and potentially prevent PTS; however, several recent randomized trials have found no specific benefit to compression therapy in preventing PTS [9-14]. Use of graded compression stockings in conjunction with additional measures, such as leg elevation, may be recommended in addition to anticoagulation on an individualized basis for patient comfort and symptom management.

Variant 7: Acute iliofemoral DVT in a pregnant patient with moderate to severe symptoms. D. Surgical thrombectomy with or without stent placement

There is no relevant literature defining the benefit of surgical therapies for pregnancy-related iliofemoral DVT compared with anticoagulation or catheter-based therapies in prospective randomized controlled trials. Observational reports have described surgical thrombectomy with or without temporary arteriovenous fistula creation for management of DVT in pregnancy [21,44], with one study reporting 5 of 97 cases resulting in fetal demise, a 16.5% early thrombosis rate, and a secondary patency rate of 89.5% [45]. Surgical thrombectomy and arteriovenous fistula creation may be considered in the second or third trimester as well to avoid radiation [21,44].

Depending on circumstances, optimal management could include anticoagulation until term followed by thrombectomy if indicated for severe symptomatic DVT in the postpartum period [21,43].

Summary of Highlights

- **Variant 1:** Anticoagulation alone is usually appropriate for a patient with acute iliofemoral DVT with mild symptoms <14 days, otherwise healthy.
- **Variant 2:** Anticoagulation alone or in conjunction with CDT/PMT with or without stent placement is usually appropriate for a patient with acute iliofemoral DVT with moderate to severe symptoms present for <14 days, otherwise healthy. These procedures may be complementary (ie, both may be performed to effectively manage the patient's care), particularly in patients <65 years of age.
- **Variant 3:** Anticoagulation alone is usually appropriate for a patient with acute femoropopliteal DVT with mild to moderate symptoms present for <14 days, otherwise

healthy.

- **Variant 4:** Additional CDT/PMT with or without stent placement in conjunction with anticoagulation is usually appropriate for a patient with acute iliofemoral DVT and symptoms <14 days when cross-sectional imaging of the patient is consistent with May-Thurner syndrome.
- **Variant 5:** CDT/PMT with or without stent placement or surgical thrombectomy with or without stent placement is usually appropriate for a patient with acute iliofemoral DVT and limb-threatening ischemia (phlegmasia cerulea dolens). These interventions are equivalent alternatives (ie, only one procedure will be ordered to provide the clinical information to effectively manage the patient's care).
- **Variant 6:** Anticoagulation alone, CDT/PMT with or without stent placement, or graded compression stocking therapy may be appropriate for a patient with iliofemoral DVT with persistent moderate symptoms at least 3 months after initial treatment with anticoagulation alone. The panel did not agree on recommending surgical thrombectomy with or without stent placement for this particular clinical scenario. There is insufficient medical literature to conclude whether or not these patients would benefit from this intervention. Intervention in this patient population is controversial but may be appropriate.
- **Variant 7:** Anticoagulation alone is usually appropriate for a patient with acute iliofemoral DVT in a pregnant patient with moderate to severe symptoms.

Supporting Documents

The evidence table, literature search, and appendix for this topic are available at https://acsearch.acr.org/list. The appendix includes the strength of evidence assessment and the final rating round tabulations for each recommendation.

For additional information on the Appropriateness Criteria methodology and other supporting documents, please go to the ACR website at https://www.acr.org/Clinical-Resources/Clinical-Tools-and-Reference/Appropriateness-Criteria.

Gender Equality and Inclusivity Clause

The ACR acknowledges the limitations in applying inclusive language when citing research studies that predates the use of the current understanding of language inclusive of diversity in sex, intersex, gender, and gender-diverse people. The data variables regarding sex and gender used in the cited literature will not be changed. However, this guideline will use the terminology and definitions as proposed by the National Institutes of Health.

Safety Considerations in Pregnant Patients

Imaging of the pregnant patient can be challenging, particularly with respect to minimizing radiation exposure and risk. For further information and guidance, see the following ACR documents:

· ACR–SPR Practice Parameter for the Safe and Optimal Performance of Fetal Magnetic Resonance Imaging (MRI)

· ACR-SPR Practice Parameter for Imaging Pregnant or Potentially Pregnant Patients with Ionizing Radiation

· ACR-ACOG-AIUM-SMFM-SRU Practice Parameter for the Performance of Standard Diagnostic Obstetrical Ultrasound

- ACR Manual on Contrast Media
- ACR Manual on MR Safety

Appropriateness Category Names and Definitions

Appropriateness Category Name	Appropriateness Rating	Appropriateness Category Definition
Usually Appropriate	7, 8, or 9	The imaging procedure or treatment is indicated in the specified clinical scenarios at a favorable risk-benefit ratio for patients.
May Be Appropriate	4, 5, or 6	The imaging procedure or treatment may be indicated in the specified clinical scenarios as an alternative to imaging procedures or treatments with a more favorable risk-benefit ratio, or the risk-benefit ratio for patients is equivocal.
May Be Appropriate (Disagreement)	5	The individual ratings are too dispersed from the panel median. The different label provides transparency regarding the panel's recommendation. "May be appropriate" is the rating category and a rating of 5 is assigned.
Usually Not Appropriate	1, 2, or 3	The imaging procedure or treatment is unlikely to be indicated in the specified clinical scenarios, or the risk-benefit ratio for patients is likely to be unfavorable.

References

1. Grosse SD, Nelson RE, Nyarko KA, Richardson LC, Raskob GE. The economic burden of incident venous thromboembolism in the United States: A review of estimated attributable healthcare costs. [Review]. Thrombosis Research. 137:3-10, 2016 Jan.
2. Sudheendra D, Vedantham S. Catheter-Directed Therapy Options for Iliofemoral Venous Thrombosis. [Review]. Surgical Clinics of North America. 98(2):255-265, 2018 Apr.
3. Haig Y, Enden T, Grotta O, et al. Post-thrombotic syndrome after catheter-directed thrombolysis for deep vein thrombosis (CaVenT): 5-year follow-up results of an open-label, randomised controlled trial. The Lancet Haematology. 3(2):e64-71, 2016 Feb.
4. Kearon C, Akl EA, Comerota AJ, et al. Antithrombotic therapy for VTE disease: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines.[Erratum appears in Chest. 2012 Dec;142(6):1698-1704]. Chest. 141(2 Suppl):e419S-e496S, 2012 Feb.
5. Kearon C, Akl EA, Ornelas J, et al. Antithrombotic Therapy for VTE Disease: CHEST Guideline and Expert Panel Report. Chest. 149(2):315-352, 2016 Feb.
6. Minocha J, Smith AM, Kapoor BS, et al. ACR Appropriateness Criteria R Radiologic Management of Venous Thromboembolism-Inferior Vena Cava Filters. Journal of the American College of Radiology. 16(5S):S214-S226, 2019 May.J. Am. Coll. Radiol.. 16(5S):S214-S226, 2019 May.
7. Muriel A, Jimenez D, Aujesky D, et al. Survival effects of inferior vena cava filter in patients

with acute symptomatic venous thromboembolism and a significant bleeding risk. Journal of the American College of Cardiology. 63(16):1675-83, 2014 Apr 29.

8. Vedantham S, Goldhaber SZ, Julian JA, et al. Pharmacomechanical Catheter-Directed Thrombolysis for Deep-Vein Thrombosis. New England Journal of Medicine. 377(23):2240-2252, 2017 12 07.

9. Burgstaller JM, Steurer J, Held U, Amann-Vesti B. Efficacy of compression stockings in preventing post-thrombotic syndrome in patients with deep venous thrombosis: a systematic review and metaanalysis. [Review]. Vasa. 45(2):141-7, 2016.

10. Jayaraj A, Meissner M. Impact of graduated compression stockings on the prevention of post-thrombotic syndrome - results of a randomized controlled trial. Phlebology. 30(8):541-8, 2015 Sep.PHLEBOLOGY. 30(8):541-8, 2015 Sep.

11. Kahn SR, Shapiro S, Wells PS, et al. Compression stockings to prevent post-thrombotic syndrome: a randomised placebo-controlled trial. Lancet. 383(9920):880-8, 2014 Mar 08.

12. Mol GC, van de Ree MA, Klok FA, et al. One versus two years of elastic compression stockings for prevention of post-thrombotic syndrome (OCTAVIA study): randomised controlled trial. BMJ. 353:i2691, 2016 May 31.BMJ. 353:i2691, 2016 May 31.

13. Skervin AL, Thapar A, Franchini AJ, Prandoni P, Shalhoub J, Davies AH. Systematic Review and Meta-Analysis of Utility of Graduated Compression Stockings in Prevention of Post-Thrombotic Syndrome. [Review]. European Journal of Vascular & Endovascular Surgery. 51(6):838-45, 2016 Jun.

14. Subbiah R, Aggarwal V, Zhao H, Kolluri R, Chatterjee S, Bashir R. Effect of compression stockings on post thrombotic syndrome in patients with deep vein thrombosis: a meta-analysis of randomised controlled trials. The Lancet Haematology. 3(6):e293-300, 2016 Jun.

15. Meissner MH.. Rationale and indications for aggressive early thrombus removal. [Review]. Phlebology. 27 Suppl 1:78-84, 2012 Mar.

16. Watson L, Broderick C, Armon MP. Thrombolysis for acute deep vein thrombosis. [Review][Update of Cochrane Database Syst Rev. 2014 Jan 23;(1):CD002783; PMID: 24452314]. Cochrane Database of Systematic Reviews. 11:CD002783, 2016 11 10.

17. Comerota AJ, Kearon C, Gu CS, et al. Endovascular Thrombus Removal for Acute Iliofemoral Deep Vein Thrombosis. Circulation. 139(9):1162-1173, 2019 Feb 26.

18. Hogg K, Kimpton M, Carrier M, Coyle D, Forgie M, Wells P. Estimating quality of life in acute venous thrombosis. JAMA Internal Medicine. 173(12):1067-72, 2013 Jun 24.

19. Cakir V, Gulcu A, Akay E, et al. Use of percutaneous aspiration thrombectomy vs. anticoagulation therapy to treat acute iliofemoral venous thrombosis: 1-year follow-up results of a randomised, clinical trial. Cardiovasc Intervent Radiol. 37(4):969-76, 2014 Aug.

20. Holper P, Kotelis D, Attigah N, Hyhlik-Durr A, Bockler D. Longterm results after surgical thrombectomy and simultaneous stenting for symptomatic iliofemoral venous thrombosis. Eur J Vasc Endovasc Surg. 39(3):349-55, 2010 Mar.

21. Koopmann MC, McLafferty RB. Advances in Operative Thrombectomy for Lower Extremity Venous Thrombosis. [Review]. Surg Clin North Am. 98(2):267-277, 2018 Apr.

22. Plate G, Eklof B, Norgren L, Ohlin P, Dahlstrom JA. Venous thrombectomy for iliofemoral vein thrombosis--10-year results of a prospective randomised study. Eur J Vasc Endovasc

Surg. 14(5):367-74, 1997 Nov.

23. Rodriguez LE, Aboukheir-Aboukheir A, Figueroa-Vicente R, et al. Hybrid operative thrombectomy is noninferior to percutaneous techniques for the treatment of acute iliofemoral deep venous thrombosis. J Vasc Surg Venous Lymphat Disord. 5(2):177-184, 2017 03.

24. Birn J, Vedantham S. May-Thurner syndrome and other obstructive iliac vein lesions: meaning, myth, and mystery. [Review]. Vascular Medicine. 20(1):74-83, 2015 Feb.Vasc Med. 20(1):74-83, 2015 Feb.

25. Hartung O, Benmiloud F, Barthelemy P, Dubuc M, Boufi M, Alimi YS. Late results of surgical venous thrombectomy with iliocaval stenting. J Vasc Surg. 47(2):381-7, 2008 Feb.

26. Mickley V, Schwagierek R, Rilinger N, Gorich J, Sunder-Plassmann L. Left iliac venous thrombosis caused by venous spur: treatment with thrombectomy and stent implantation. J Vasc Surg. 28(3):492-7, 1998 Sep.

27. Ming ZB, Li WD, Yuan RF, Li XQ, Ding WB. Effectiveness of catheter directed thrombolysis and stent implantation on iliofemoral vein thrombosis caused by iliac vein compression. Journal of Thrombosis & Thrombolysis. 44(2):254-260, 2017 Aug.

28. Park JY, Ahn JH, Jeon YS, Cho SG, Kim JY, Hong KC. Iliac vein stenting as a durable option for residual stenosis after catheter-directed thrombolysis and angioplasty of iliofemoral deep vein thrombosis secondary to May-Thurner syndrome. Phlebology. 29(7):461-70, 2014 Aug.

29. Zhu QH, Zhou CY, Chen Y, et al. Percutaneous manual aspiration thrombectomy followed by stenting for iliac vein compression syndrome with secondary acute isolated iliofemoral deep vein thrombosis: a prospective study of single-session endovascular protocol. European Journal of Vascular & Endovascular Surgery. 47(1):68-74, 2014 Jan.Eur J Vasc Endovasc Surg. 47(1):68-74, 2014 Jan.

30. Igari K, Kudo T, Toyofuku T, Jibiki M, Inoue Y. Surgical thrombectomy and simultaneous stenting for deep venous thrombosis caused by iliac vein compression syndrome (May-Thurner syndrome). Annals of Thoracic & Cardiovascular Surgery. 20(6):995-1000, 2014.Ann Thorac Cardiovasc Surg. 20(6):995-1000, 2014.

31. Laohapensang K, Hanpipat S, Aworn S, Orrapin S. Surgical venous thrombectomy for phlegmasia cerulea dolens and venous gangrene of the lower extremities. Journal of the Medical Association of Thailand. 96(11):1463-9, 2013 Nov.

32. Avgerinos ED, Hager ES, Naddaf A, Dillavou E, Singh M, Chaer RA. Outcomes and predictors of failure of thrombolysis for iliofemoral deep venous thrombosis. Journal of Vascular Surgery. 3(1):35-41, 2015 Jan.

33. Ruihua W, Xin W, Guang L, et al. Technique and Clinical Outcomes of Combined Stent Placement for Postthrombotic Chronic Total Occlusions of the Iliofemoral Veins. Journal of Vascular & Interventional Radiology. 28(3):373-379, 2017 Mar.

34. Sarici IS, Yanar F, Agcaoglu O, et al. Our early experience with iliofemoral vein stenting in patients with post-thrombotic syndrome. Phlebology. 29(5):298-303, 2014 Jun.

35. Ye K, Lu X, Jiang M, et al. Technical details and clinical outcomes of transpopliteal venous stent placement for postthrombotic chronic total occlusion of the iliofemoral vein. Journal of Vascular & Interventional Radiology. 25(6):925-32, 2014 Jun.J Vasc Interv Radiol.

25(6):925-32, 2014 Jun.

36. Yin M, Shi H, Ye K, et al. Clinical Assessment of Endovascular Stenting Compared with Compression Therapy Alone in Post-thrombotic Patients with Iliofemoral Obstruction. European Journal of Vascular & Endovascular Surgery. 50(1):101-7, 2015 Jul.

37. Zhang X, Ren Q, Jiang X, et al. A prospective randomized trial of catheter-directed thrombolysis with additional balloon dilatation for iliofemoral deep venous thrombosis: a single-center experience. Cardiovascular & Interventional Radiology. 37(4):958-68, 2014 Aug.

38. Vogel D, Comerota AJ, Al-Jabouri M, Assi ZI. Common femoral endovenectomy with iliocaval endoluminal recanalization improves symptoms and quality of life in patients with postthrombotic iliofemoral obstruction. Journal of Vascular Surgery. 55(1):129-35, 2012 Jan.

39. Pokrovsky A, Ignatyev I, Gradusov E. First Experience of Performing Hybrid Operations in Chronic Venous Obstructions of Iliofemoral Segments in Patients With Postthrombotic Syndrome. Vasc Endovascular Surg. 51(7):447-452, 2017 Oct.

40. Shaydakov E, Porembskaya O, Geroulakos G. The May-Husni Procedure: A Reappraisal. [Review]. Eur J Vasc Endovasc Surg. 50(4):513-7, 2015 Oct.

41. Bates SM, Middeldorp S, Rodger M, James AH, Greer I. Guidance for the treatment and prevention of obstetric-associated venous thromboembolism. J Thromb Thrombolysis. 41(1):92-128, 2016 Jan.

42. Bloom AI, Farkas A, Kalish Y, Elchalal U, Spectre G. Pharmacomechanical catheter-directed thrombolysis for pregnancy-related iliofemoral deep vein thrombosis. Journal of Vascular & Interventional Radiology. 26(7):992-1000, 2015 Jul.J Vasc Interv Radiol. 26(7):992-1000, 2015 Jul.

43. Devis P, Knuttinen MG. Deep venous thrombosis in pregnancy: incidence, pathogenesis and endovascular management. [Review]. Cardiovasc. diagn. ther.. 7(Suppl 3):S309-S319, 2017 Dec.

44. Herrera S, Comerota AJ, Thakur S, et al. Managing iliofemoral deep venous thrombosis of pregnancy with a strategy of thrombus removal is safe and avoids post-thrombotic morbidity. Journal of Vascular Surgery. 59(2):456-64, 2014 Feb.J Vasc Surg. 59(2):456-64, 2014 Feb.

45. Pillny M, Sandmann W, Luther B, et al. Deep venous thrombosis during pregnancy and after delivery: indications for and results of thrombectomy. Journal of Vascular Surgery. 37(3):528-32, 2003 Mar.J Vasc Surg. 37(3):528-32, 2003 Mar.

46. American College of Radiology. ACR–SPR Practice Parameter for the Safe and Optimal Performance of Fetal Magnetic Resonance Imaging (MRI). Available at: https://gravitas.acr.org/PPTS/GetDocumentView?docId=89+&releaseId=2.

47. American College of Radiology. ACR–SPR Practice Parameter for Imaging Pregnant or Potentially Pregnant Patients with Ionizing Radiation. Available at: https://gravitas.acr.org/PPTS/GetDocumentView?docId=23+&releaseId=2.

48. American College of Radiology. ACR-ACOG-AIUM-SMFM-SRU Practice Parameter for the Performance of Standard Diagnostic Obstetrical Ultrasound. Available at: https://gravitas.acr.org/PPTS/GetDocumentView?docId=28+&releaseId=2.

49. American College of Radiology. Manual on Contrast Media. Available at: https://www.acr.org/Clinical-Resources/Contrast-Manual.

50. Expert Panel on MR Safety, Kanal E, Barkovich AJ, et al. ACR guidance document on MR safe practices: 2013. J Magn Reson Imaging. 37(3):501-30, 2013 Mar.

Disclaimer

The ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

[a]Charles T. Dotter Department of Interventional Radiology, Portland, Oregon. [b]Panel Chair, Cleveland Clinic, Cleveland, Ohio. [c]Panel Vice-Chair, University of California San Francisco, San Francisco, California. [d]Desert Regional Medical Center, Palm Springs, California. [e]Zucker School of Medicine at Hofstra Northwell, Hempstead, New York. [f]Tufts University School of Medicine, Boston, Massachusetts; Society for Vascular Surgery. [g]Renaissance School of Medicine at Stony Brook University, Stony Brook, New York. [h]Boston University School of Medicine, Boston, Massachusetts. [i]Froedtert & The Medical College of Wisconsin, Milwaukee, Wisconsin. [j]David Geffen School of Medicine at UCLA, Los Angeles, California. [k]University of Nebraska Medical Center, Omaha, Nebraska. [l]University of California San Diego, San Diego, California. [m]University of Colorado Denver Anschutz Medical Campus, Aurora, Colorado. [n]UT Southwestern Medical Center, Dallas, Texas. [o]Specialty Chair, University of Chicago Hospital, Chicago, Illinois.