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Inherited Thrombophilias in Pregnancy

Inherited thrombophilias are associated with an increased risk of venous thromboembolism and also have been linked to adverse outcomes in pregnancy. However, there is limited evidence to guide screening for and management of these conditions in pregnancy. The purpose of this document is to review common thrombophilias and their association with maternal venous thromboembolism risk and adverse pregnancy outcomes, indications for screening to detect these conditions, and management options in pregnancy.

Background

The Hemostatic Paradox of Pregnancy

Pregnancy poses a particularly complex hemostatic challenge. Successful pregnancy requires the avoidance of hemorrhage during implantation, endovascular cytotrophoblast remodeling of maternal spiral arteries, and during the third stage of labor, yet also requires the maintenance of a fluid uteroplacental circulation. Maintaining hemostatic balance during pregnancy requires alterations in both local uterine and systemic clotting, as well as anticoagulant and fibrinolytic proteins. The decidual layer of the uterus plays a crucial role in the prevention of hemorrhage during implantation, placentation, and the third stage of labor (1, 2). Confirmation of the crucial role that the decidua plays in the maintenance of gestational hemostasis is seen in the hemorrhage associated with obstetric conditions marked by absent or impaired decidua (eg, ectopic pregnancy and placenta accreta). Conversely, decidual tissue factor also can promote the intense hypofibrinogenemia and disseminated intravascular coagulation observed in decidual hemorrhage (ie, placental abruption).

Pregnancy is marked by increased clotting potential, decreased anticoagulant activity, and decreased fibrinolysis (3–5). The thrombotic potential of pregnancy is exacerbated by venous stasis in the lower extremities due to compression of the inferior vena cava and pelvic veins by the enlarging uterus, a hormone-mediated increase in venous capacitance, insulin resistance, and hyperlipidemia. Thus, it is not surprising that venous thromboembolism complicates approximately 1 in 1,600 births and is a leading cause of maternal morbidity in the United States (6, 7).

There is a strong association between inherited thrombophilias and venous thromboembolism, which makes detection of these mutations a logical target for prevention strategies (Table 1). However, it is controversial whether there is an association between inherited thrombophilias and uteroplacental thrombosis that lead to adverse pregnancy outcomes such as fetal loss, preeclampsia, fetal growth restriction, and placental abruption (8). This possible association has resulted in increased screening for thrombophilias in pregnancy, although there has been no confirmation of treatment benefits.

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Table 1. Risk of Venous Thromboembolism With Different Thrombophilias

| | Prevalence in General Population (%) | VTE Risk per Pregnancy (No History) (%) | VTE Risk per Pregnancy (Previous VTE) (%) | Percentage of All VTE | References |
|---|--------------------------------------|---|---|-----------------------|------------|
| Factor V Leiden heterozygote | 1–15 | <0.3 | 10 | 40 | 1–4 |
| Factor V Leiden homozygote | <1 | 1.5 | 17 | 2 | 1–4 |
| Prothrombin gene heterozygote | 2–5 | <0.5 | >10 | 17 | 1–4 |
| Prothrombin gene homozygote | <1 | 2.8 | >17 | 0.5 | 1–4 |
| Factor V Leiden/prothrombin double heterozygote | 0.01 | 4.7 | >20 | 1–3 | 1–4 |
| Antithrombin III activity (<60%) | 0.02 | 3–7 | 40 | 1 | 1, 5, 6 |
| Protein C activity (<50%) | 0.2–0.4 | 0.1–0.8 | 4–17 | 14 | 1, 5, 7 |
| Protein S free antigen (<55%) | 0.03–0.13 | 0.1 | 0–22 | 3 | 1, 8–10 |

Abbreviation: VTE, venous thromboembolism.

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Prevalence of Common Inherited Thrombophilias

Factor V Leiden

The prevalence of the factor V Leiden mutation in European populations is approximately 5% (9). Although the mutation is virtually absent in black Africans, Chinese, Japanese, and other Asian populations, it is present in 3% of African Americans whose ancestors are not recent immigrants. The mutation renders factor V refractory to proteolysis by activated protein C. Women who are heterozygous for factor V Leiden have been observed to account for approximately 40% of cases of venous thromboembolism during pregnancy; however, the risk of venous thromboembolism among pregnant women who are heterozygous for factor V Leiden without a

personal history of venous thromboembolism or an affected first-degree relative with a thrombotic episode before age 50 years is less than 0.3% (10, 11). In contrast, this risk increases to at least 10% among pregnant women with a personal or family history of venous thromboembolism (11). Pregnant women who are homozygous for factor V Leiden without a personal history of venous thromboembolism or an affected first-degree relative have a 1–2% risk for venous thromboembolism, whereas those with such a history have a 17% risk (11).

Prothrombin G20210A

The prothrombin G20210A mutation is a point mutation that results in elevated circulating prothrombin levels (9). The prothrombin G20210A mutation is present in approximately 3% of the European population, and it

has been reported to account for 17% of cases of venous thromboembolism in pregnancy (10). As with factor V Leiden, a personal history or history of venous thromboembolism in a first-degree relative before age 50 years increases the risk of venous thromboembolism in pregnancy. Without such a history, carriers of the prothrombin *G20210A* mutation have a less than 0.5% risk of venous thromboembolism during pregnancy; for a carrier with such a history, the risk exceeds 10% (10). Pregnant women who are homozygous for the prothrombin *G20210A* mutation without a personal or positive family history have a 2–3% risk of venous thromboembolism in pregnancy, whereas such a history confers a substantially greater risk. The combination of factor V Leiden and prothrombin *G20210A* mutations has synergistic hypercoagulable effects. Those who are heterozygous for this combination, although present in only 1 per 10,000 patients, have a 4–5% risk of venous thromboembolism even without a personal or positive family history (10, 11).

Protein C Deficiency

Protein C deficiency has been linked to more than 160 distinct mutations that produce a highly variable phenotype (9). The prevalence of protein C deficiency is 0.2–0.3% when determined by a functional assay with a cutoff of 50–60%. The risk of venous thromboembolism in pregnancy among the typical protein C deficient patient with a personal or family history has been reported to be 2–7% (12, 13). Although rare, newborns homozygous for protein C deficiency will develop neonatal purpura fulminans and require lifetime anticoagulation (14).

Protein S Deficiency

Protein S deficiency generally has two causes, a silenced gene, or a mutation, which results in reduced free protein S antigen levels and activity (9). Detection of protein S deficiency using activity assays alone is subject to substantial variability due to fluctuating levels of protein S binding protein in pregnancy (15). Therefore, screening in nonpregnant women is more reliable (16). However, if screening in pregnancy is necessary, cutoff values for free protein S antigen levels in the second and third trimesters have been identified at less than 30% and less than 24%, respectively (4). Among those with a positive family history, the risk of venous thromboembolism in pregnancy has been reported to be 6–7% (17). As with protein C deficiency, homozygous protein S deficiency results in neonatal purpura fulminans (14).

Antithrombin deficiency

Antithrombin deficiency is highly thrombogenic but rare. The more than 250 associated mutations can decrease gene transcription, leading to reductions in both antigen

and activity, or alter structure and function leading to normal antigen levels but decreased activity (9, 18). The very rare homozygous state is associated with little or no antithrombin activity. The prevalence of antithrombin deficiency is approximately 1 per 2,500 patients (18, 19). In nonpregnant patients, the risk of venous thromboembolism among antithrombin-deficient patients is increased more than 25-fold (18). Pregnancy may increase the thrombogenic potential of antithrombin deficiency substantially (13, 17). However, this risk may be much lower in the absence of a positive personal or family history (11).

Methylenetetrahydrofolate Reductase Mutations

Homozygosity for the methylenetetrahydrofolate reductase (MTHFR) gene mutations is the most common cause of hyperhomocysteinemia. Homozygosity for the MTHFR C677T and A1298C polymorphisms is present in 10–16% and 4–6% of all Europeans, respectively (20). However, MTHFR mutations by themselves do not appear to convey an increased risk for venous thromboembolism in either nonpregnant (21) or pregnant women (22). Although hyperhomocysteinemia was previously reported to be a modest risk factor of venous thromboembolism (23, 24), recent data indicate that elevated homocysteine levels are a weak risk factor of venous thromboembolism (25). This observation may reflect the folate-replete diet of developed nations, including folate supplementation of flour in the United States. Moreover, intervention studies with vitamin B supplementation in nonpregnant patients show no reduction in venous thromboembolism (26, 27). Thus, there is insufficient evidence to support assessment of MTHFR polymorphisms or measurement of fasting homocysteine levels in the evaluation of a thrombophilic etiology for venous thromboembolism and, therefore, it is not recommended.

Other Thrombophilias

A variety of other thrombophilias have been described, including alternative mutations in the factor V gene, a promoter mutation in the *PAI-1* gene, protein Z deficiency, and activity-enhancing mutations in various clotting factor genes. Although they appear to exert little independent risk of venous thromboembolism, they may exacerbate risk among patients with the aforementioned mutations. However, there is insufficient evidence to recommend screening for these thrombophilias.

Inherited Thrombophilias and Adverse Pregnancy Outcomes

A definitive causal link cannot be made between inherited thrombophilias and adverse pregnancy outcomes.

Most of the available studies are small case-control and cohort studies assembled in heterogeneous populations, are frequently contradictory, and display potential reporting biases (28, 29).

Fetal Loss

Whereas meta-analyses and a retrospective cohort study have revealed an association between inherited thrombophilias and first-trimester pregnancy loss, (30–34) prospective cohort studies have found no association between inherited thrombophilias and fetal loss. The *Eunice Kennedy Shriver* National Institute of Child Health and Human Development's Maternal-Fetal Medicine Units Network tested low-risk women with a singleton pregnancy less than 14 weeks of gestation. The Maternal-Fetal Medicine Units Network identified 134 women who were heterozygous for factor V Leiden among 4,885 pregnant women, and found no increase in the incidence of fetal loss (35). Similar findings of no increased risk of fetal loss were noted for maternal carriers of the prothrombin *G20210A* gene mutation (36).

Preeclampsia

Some clinical studies have reported a link between factor V Leiden and preeclampsia, severe preeclampsia, and preeclampsia before 37 weeks of gestation (37, 38). However, multiple other case-control studies have failed to demonstrate an association between factor V Leiden mutation and preeclampsia (35, 39–42).

Multiple studies also have failed to establish a link between prothrombin *G20210A* mutation and either preeclampsia or severe preeclampsia (35, 36, 41, 43–45). Several meta-analyses have suggested an association between protein C and protein S deficiency and preeclampsia; however, these conclusions are based on a small number of studies that also contained small numbers of participants (46). There is insufficient evidence to conclude that inherited thrombophilias are associated with an increased occurrence of preeclampsia.

Intrauterine Growth Restriction

Multiple case-control, cohort, and systematic review studies have failed to detect a significant association between factor V Leiden and intrauterine growth restriction (IUGR) less than the 10th percentile or less than the 5th percentile (37, 41, 47). A similar lack of association was noted between prothrombin *G20210A* mutation and IUGR (36, 48, 49). A case-control study among 493 newborns with IUGR and 472 matched controls found no association between IUGR and factor V Leiden, prothrombin *G20210A* mutation, or MTHFR mutations (50).

Placental Abruption

Overall, there is insufficient evidence to establish a link between thrombophilias and placental abruption. Prospective cohort analyses of factor V Leiden, prothrombin *G20210A*, and pregnancy outcome found no association with placental abruption (35, 36). However, a meta-analysis of case-control studies reported an association between placental abruption and both homozygosity and heterozygosity for the factor V Leiden mutation and a link between prothrombin *G20210A* mutation heterozygosity and placental abruption (46). The Hordaland Homocysteine Study found an association between placental abruption and hyperhomocysteinemia greater than 15 micromol/L (51), but minimal association between homozygosity for the C677T MTHFR polymorphism and placental abruption (52).

Clinical Considerations and Recommendations

► Who are candidates for thrombophilia evaluation?

Screening for thrombophilias is controversial. It is useful only when results will affect management decisions, and is not useful in situations where treatment is indicated for other risk factors. Screening may be considered in the following clinical settings:

- A personal history of venous thromboembolism that was associated with a nonrecurrent risk factor (eg, fractures, surgery, and prolonged immobilization). The recurrence risk among untreated pregnant women with such a history and a thrombophilia was 16% (odds ratio, 6.5; 95% confidence interval, 0.8–56.3) (53).
- A first-degree relative (eg, parent or sibling) with a history of high-risk thrombophilia or venous thromboembolism before age 50 years in the absence of other risk factors inasmuch as affected women should receive prophylaxis

In other situations, thrombophilia testing is not routinely recommended. Testing for inherited thrombophilias in women who have experienced recurrent fetal loss or placental abruption is not recommended. Although there may be an association in these cases, there is insufficient clinical evidence that antepartum prophylaxis with unfractionated heparin or low molecular weight heparin (LMWH) prevents recurrence in these patients (54). However, screening for antiphospholipid antibodies may be appropriate in patients experiencing

fetal loss (see Practice Bulletin No. 68, *Antiphospholipid Syndrome*, November 2005). In addition, there is insufficient evidence of an association and, therefore, insufficient evidence to either screen for or treat women with inherited thrombophilias and obstetric histories that include complications such as IUGR or preeclampsia.

► **What laboratory tests are recommended for thrombophilia screening?**

Recommended tests for inherited thrombophilias are listed in Table 2. Whenever possible, laboratory testing should be performed remote (after 6 weeks) from the thrombotic event and while the patient is not pregnant and not taking anticoagulation or hormonal therapy.

Ideally, protein S deficiency should be assessed initially by performing a functional assay remote from pregnancy. A value less than 55% should be followed up by assessing free protein S levels. In the nonpregnant state, a free protein S antigen value less than 55% is consistent with protein S deficiency. In pregnancy, it is unclear what protein S activity value is diagnostic, but free protein S cutoffs of less than 30% and less than 24% may be used in the second and third trimesters, respectively.

Because of the lack of association between MTHFR and negative pregnancy outcomes, screening with fasting homocysteine levels or MTHFR mutation analyses are not recommended.

► **What anticoagulant regimens are available for pregnant women?**

Given the risk and benefit ratio of unfractionated heparin, LMWH generally is the preferred agent for prophylaxis in pregnancy. The need to adjust the LMWH

dose according to anti-Xa levels is controversial. The therapeutic range for prophylaxis is uncertain, and dose adjustment to reach target anti-Xa levels has not been shown to increase safety or efficacy of prophylaxis. It is not possible to make definitive recommendations about which prophylactic regimen of unfractionated heparin should be used if active prophylaxis is chosen. All patients with inherited thrombophilias should undergo individualized risk assessment, which may modify management decisions. Various unfractionated heparin and LMWH regimens are described in Table 3.

► **In which patients should treatment be considered to prevent venous thromboembolism?**

The decision to treat with thromboprophylaxis, anticoagulant therapy, or no pharmacologic treatment (antepartum surveillance) is influenced by the venous thromboembolism history, severity of inherited thrombophilia, and additional risk factors. All patients with inherited thrombophilias should undergo individualized risk assessment, which may modify management decisions. The decision regarding intensity of treatment may be shaped by other risk factors, such as cesarean delivery, prolonged immobility, obesity, and family history of thrombophilia or venous thromboembolism. Treatment recommendations are listed in Table 4.

For women receiving prolonged anticoagulation for a venous thromboembolism episode who become pregnant, it is recommended that unfractionated heparin or LMWH be used in place of vitamin K antagonists. Low molecular weight heparin is preferred over unfractionated heparin for the prevention and treatment of venous thromboembolism in pregnant women. Any increased risk of venous thromboembolism in pregnancy appears to be greatest before 20 weeks of gestation; therefore, if antepartum

Table 2. How to Test for Thrombophilias

| Thrombophilia | Testing Method | Is Testing Reliable During Pregnancy? | Is Testing Reliable During Acute Thrombosis? | Is Testing Reliable With Anti-coagulation? |
|-----------------------------------|--|---------------------------------------|--|--|
| Factor V Leiden mutation | Activated protein C resistance assay (second generation) | Yes | Yes | No |
| | If abnormal: DNA analysis | Yes | Yes | Yes |
| Prothrombin gene mutation G20210A | DNA analysis | Yes | Yes | Yes |
| Protein C deficiency | Protein C activity (<60%) | Yes | No | No |
| Protein S deficiency | Functional assay (<55%) | No* | No | No |
| Antithrombin deficiency | Antithrombin activity (<60%) | Yes | No | No |

*If screening in pregnancy is necessary, cutoff values for free protein S antigen levels in the second and third trimesters have been identified at less than 30% and less than 24%, respectively.

Table 3. Anticoagulation Regimen Definitions

| Anticoagulation Regimen | Definition |
|----------------------------|--|
| Prophylactic LMWH* | Enoxaparin, 40 mg SC once daily Dalteparin, 5,000 units SC once daily Tinzaparin, 4,500 units SC once daily |
| Therapeutic† LMWH | Enoxaparin, 1 mg/kg every 12 hours Dalteparin, 200 units/kg once daily Tinzaparin, 175 units/kg once daily Dalteparin, 100 units/kg every 12 hours May target an anti-Xa level in the therapeutic range of 0.6–1.0 units/mL for twice daily regimen; slightly higher doses may be needed for a once-daily regimen. |
| Minidose prophylactic UFH | UFH, 5,000 units SC every 12 hours |
| Prophylactic UFH | UFH, 5,000–10,000 units SC every 12 hours UFH, 5,000–7,500 units SC every 12 hours in first trimester UFH, 7,500–10,000 units SC every 12 hours in the second trimester UFH, 10,000 units SC every 12 hours in the third trimester, unless the aPTT is elevated |
| Therapeutic UFH† | UFH, 10,000 units or more SC every 12 hours in doses adjusted to target aPTT in the therapeutic range (1.5–2.5) 6 hours after injection |
| Postpartum anticoagulation | Prophylactic LMWH/UFH for 4–6 weeks or vitamin K antagonists for 4–6 weeks with a target INR of 2.0–3.0, with initial UFH or LMWH therapy overlap until the INR is 2.0 or more for 2 days |
| Surveillance | Clinical vigilance and appropriate objective investigation of women with symptoms suspicious of deep vein thrombosis or pulmonary embolism |

Abbreviations: aPTT, activated partial thromboplastin time; INR, international normalized ratio; LMWH, low molecular weight heparin; SC, subcutaneously; UFH, unfractionated heparin.

*Although at extremes of body weight, modification of dose may be required.

†Also referred to as weight adjusted, full treatment dose

prophylaxis is used, it should be initiated in the first trimester. Postpartum treatment levels should be greater than or equal to antepartum treatment. Women using warfarin or unfractionated heparin who are breastfeeding can continue taking these medications (55–57). Women using LMWH can continue this thromboprophylaxis, although this recommendation is based on limited evidence.

For all women with a previous history of deep vein thrombosis, the use of graduated elastic compression stockings may be considered in the antepartum and postpartum periods (58).

► *What is appropriate intrapartum management for thrombophilic patients?*

The use of pneumatic compression boots or elastic stockings should be considered for patients with a known thrombophilia until they are ambulatory postpartum. In addition, intrapartum prophylaxis with unfractionated heparin should be considered in patients at higher risk.

Regardless of whether the patient is receiving prophylactic, intermediate, or therapeutic doses of LMWH,

consideration should be given to substituting a comparable dose of unfractionated heparin at 36 weeks of gestation to permit induction of neuroaxial anesthesia during labor and delivery. Alternatively, adjusted-dose subcutaneous LMWH or unfractionated heparin can be discontinued 24–36 hours before an induction of labor or scheduled cesarean delivery to avoid the anticoagulant effect during delivery.

Patients receiving prophylactic anticoagulation should be instructed to withhold their injections at the onset of labor. If vaginal or cesarean delivery occurs more than 4 hours after a prophylactic dose of unfractionated heparin, the patient is not at significant risk of hemorrhagic complications. Beyond 12 hours after a prophylactic dose or 24 hours after a therapeutic dose of LMWH, spinal anesthesia should not be withheld because the risk of procedure-related bleeding is limited (59, 60). Patients receiving unfractionated heparin or LMWH who require rapid reversal of the anticoagulant effect for delivery can be treated with protamine sulfate (61). In addition, antithrombin concentrates can be used in antithrombin-deficient patients in the peripartum period.

Table 4. Recommended Thromboprophylaxis for Pregnancies Complicated by Inherited Thrombophilias*

| Clinical Scenario | Antepartum Management | Postpartum Management |
|--|--|---|
| Low-risk thrombophilia [†] without previous VTE | Surveillance without anticoagulation therapy or prophylactic LMWH or UFH | Surveillance without anticoagulation therapy or postpartum anticoagulation therapy if the patient has additional risks factors [‡] |
| Low-risk thrombophilia [†] with a single previous episode of VTE—Not receiving long-term anticoagulation therapy | Prophylactic or intermediate-dose LMWH/UFH or surveillance without anticoagulation therapy | Postpartum anticoagulation therapy or intermediate-dose LMWH/UFH |
| High-risk thrombophilia [§] without previous VTE | Prophylactic LMWH or UFH | Postpartum anticoagulation therapy |
| High-risk thrombophilia [§] with a single previous episode of VTE—Not receiving long-term anticoagulation therapy | Prophylactic, intermediate-dose, or adjusted-dose LMWH/UFH regimen | Postpartum anticoagulation therapy or intermediate or adjusted-dose LMWH/UFH for 6 weeks (therapy level should be at least as high as antepartum treatment) |
| No thrombophilia with previous single episode of VTE associated with transient risk factor that is no longer present—Excludes pregnancy- or estrogen-related risk factor | Surveillance without anticoagulation therapy | Postpartum anticoagulation therapy |
| No thrombophilia with previous single episode of VTE associated with transient risk factor that was pregnancy- or estrogen-related | Prophylactic-dose LMWH or UFH | Postpartum anticoagulation therapy |
| No thrombophilia with previous single episode of VTE without an associated risk factor (idiopathic)—Not receiving long-term anticoagulation therapy | Prophylactic-dose LMWH or UFH | Postpartum anticoagulation therapy |
| Thrombophilia or no thrombophilia with two or more episodes of VTE—Not receiving long-term anticoagulation therapy | Prophylactic or therapeutic-dose LMWH or Prophylactic or therapeutic-dose UFH | Postpartum anticoagulation therapy or Therapeutic-dose LMWH/UFH for 6 weeks |
| Thrombophilia or no thrombophilia with two or more episodes of VTE—Receiving long-term anticoagulation therapy | Therapeutic-dose LMWH or UFH | Resumption of long-term anticoagulation therapy |

Abbreviations: LMWH, low molecular weight heparin; UFH, unfractionated heparin; VTE, venous thromboembolism.

*Postpartum treatment levels should be greater or equal to antepartum treatment. Treatment of acute VTE and management of antiphospholipid syndrome are addressed in other Practice Bulletins.

[†]Low-risk thrombophilia: factor V Leiden heterozygous; prothrombin *G20210A* heterozygous; protein C or protein S deficiency.

[‡]First-degree relative with a history of a thrombotic episode before age 50 years, or other major thrombotic risk factors (eg, obesity, prolonged immobility).

[§]High-risk thrombophilia: antithrombin deficiency; double heterozygous for prothrombin *G20210A* mutation and factor V Leiden; factor V Leiden homozygous or prothrombin *G20210A* mutation homozygous.

^{||}Surveillance without anticoagulation is supported as an alternative approach by some experts.

► ***What is the appropriate management of thrombophilic patients who require postpartum anticoagulation?***

Postpartum doses of unfractionated heparin or LMWH should be equal to or greater than antepartum therapy. Unfractionated heparin or LMWH can be restarted 4–6 hours after vaginal delivery or 6–12 hours after cesarean delivery. Patients who will be treated with warfarin may begin therapy immediately after delivery. The initial dose of warfarin should be 5 mg daily for 2 days, with subse-

quent doses determined by monitoring the international normalized ratio. To avoid paradoxical thrombosis and skin necrosis from the early antiprotein C effect of warfarin, women should be maintained on therapeutic doses of unfractionated heparin or LMWH for 5 days and until the international normalized ratio is therapeutic (2.0–3.0) for 2 consecutive days. Because warfarin, LMWH, and unfractionated heparin do not accumulate in breast milk and do not induce an anticoagulant effect in the infant, these anticoagulants are compatible with breastfeeding (55–57).

► *What postpartum contraceptive options are appropriate for women with thrombophilias?*

The risk of venous thromboembolism among women using estrogen-containing oral contraceptives increases 35–99-fold and 16-fold among women heterozygous for factor V Leiden and prothrombin *G20210A* mutations, respectively (62). The annual risk of venous thromboembolism is 5.7 per 10,000 among factor V Leiden carriers, compared with 28.5 per 10,000 among factor V Leiden heterozygous women using estrogen-containing contraceptives (relative risk of 34.7) (63). Therefore, alternative methods, such as intrauterine devices (including those containing progestin), progestin-only pills or implants, and barrier methods, should be considered. However, screening all women for thrombophilias before initiating combination contraception is not recommended (64–66).

Summary of Recommendations

The following recommendations are based on limited or inconsistent scientific evidence (Level B)

- Postpartum warfarin, LMWH, and unfractionated heparin anticoagulation may be used in women who breastfeed.
- Inherited thrombophilia testing in women who have experienced recurrent fetal loss or placental abruption is not recommended because it is unclear whether anticoagulation reduces recurrence.
- There is insufficient evidence to recommend screening or treatment for thrombophilias in women with previous IUGR or preeclampsia.
- Because of the lack of association between the MTHFR mutation and negative pregnancy outcomes, screening with fasting homocysteine levels or MTHFR mutation analyses is not recommended.

The following recommendations are based primarily on consensus and expert opinion (Level C)

- Screening for inherited thrombophilias should include factor V Leiden mutation; prothrombin *G20210A* mutation; and antithrombin, protein C, and protein S deficiencies.
- Treatment recommendations for women with inherited thrombophilias are listed in Table 4.
- All patients with inherited thrombophilias should undergo individualized risk assessment, which may modify management decisions.

Proposed Performance Measure

Documentation of individual risk assessment for women with known inherited thrombophilias

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The MEDLINE database, the Cochrane Library, and the American College of Obstetricians and Gynecologists' own internal resources and documents were used to conduct a literature search to locate relevant articles published between January 1985–February 2009. The search was restricted to articles published in the English language. Priority was given to articles reporting results of original research, although review articles and commentaries also were consulted. Abstracts of research presented at symposia and scientific conferences were not considered adequate for inclusion in this document. Guidelines published by organizations or institutions such as the National Institutes of Health and the American College of Obstetricians and Gynecologists were reviewed, and additional studies were located by reviewing bibliographies of identified articles. When reliable research was not available, expert opinions from obstetrician–gynecologists were used.

Studies were reviewed and evaluated for quality according to the method outlined by the U.S. Preventive Services Task Force:

- I Evidence obtained from at least one properly designed randomized controlled trial.
- II-1 Evidence obtained from well-designed controlled trials without randomization.
- II-2 Evidence obtained from well-designed cohort or case–control analytic studies, preferably from more than one center or research group.
- II-3 Evidence obtained from multiple time series with or without the intervention. Dramatic results in uncontrolled experiments also could be regarded as this type of evidence.
- III Opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.

Based on the highest level of evidence found in the data, recommendations are provided and graded according to the following categories:

Level A—Recommendations are based on good and consistent scientific evidence.

Level B—Recommendations are based on limited or inconsistent scientific evidence.

Level C—Recommendations are based primarily on consensus and expert opinion.

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