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Addressing the Tragedy of Maternal Mortality & Morbidity in America

A presentation for HealthTrust Members by

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Addressing the Tragedy of Maternal Mortality & Morbidity in America:
Part 4, Thromboembolism in Pregnancy

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Addressing the Tragedy of Maternal Mortality & Morbidity in America:

Part 4, Thromboembolism in Pregnancy

Learning Objectives

- Describe the risk factors of thromboembolism in pregnancy
- Explain why pregnancy is a thrombogenic state
- Recall why peripartum venous thromboprophylaxis can help prevent maternal deaths
- Identify the benefits of utilizing an evidence-based care, team approach to aid patients with venous thromboembolism (VTE)

Thromboembolism in Pregnancy

A Quality and Safety Initiative

Maternal Mortality

An American Failure

- America is the most dangerous country in the developed world to give birth
- U.S. ranks 60th in the world regarding maternal death rate
- Only developed nation in the world with increasing rate of maternal mortality
- Increased from 14 to 26.4 / 100,000 Births from 1990–2015
- Occurred during a time of unprecedented medical advancement
- Maternal death classified as “Never Event” by CHS OB Collaborative
- Greatest tragedy in modern medicine

Source: *ACOG Patient Safety and Quality Improvement.* Berg Cl et all Obstet Gynecology 2012
WHO, UNICEF, UNFPA, The World Bank and UNDP. Trends in Maternal Mortality 1990-2013:2014

Maternal Morbidity is Extreme

- Shock
- Acute Kidney Injury
- Pulmonary Embolism
- Acute Respiratory Distress Syndrome (ARDS)
- Myocardial Infarction
- Sepsis
- Increased by 45% from 2006 - 2015
- Affects 80,000 mothers per year

Sources: Callaghan, Wm. et al. Obstet, Gynecology, 2012.
K Fingar et al Trands and Disparities in Delivery Hospitalizations Involving Severe Maternal Morbidity, 2006-2015

Maternal Fetal Medicine

- Antenatal Steroids
- Antibiotics for Premature preterm rupture of membranes (PPROM)
- Magnesium for Neuroprotection
- 17 Hydroxyprogesterone for Preterm Birth Prevention
- Fetal Therapy for Twin-Twin Transfusion Syndrome, Neonatal Alloimmune Thrombocytopenia, & Neural Tube Defect
- Head/body cooling for Hypoxic Ischemic Encephalopathy

Where is the “M” in Maternal-Fetal Medicine?

Clear Need for Action

Current Commentary

Where Is the “M” in Maternal–Fetal Medicine?

Mary E. D'Alton, MD

In contrast to the generally encouraging trend regarding global maternal mortality, there has been an apparent increase in the maternal mortality ratio in the United States. Although maternal death remains a relatively rare adverse event in this country, programs to reduce maternal mortality also will result in a reduction in maternal morbidity, which is a far more prevalent problem. Progress in the field of maternal–fetal medicine over the past several decades has been largely attributable to improvements in fetal and neonatal medicine. We need to develop an organized, national approach focused on reducing maternal mortality and morbidity. The goal will be to outline a specific plan for clinical, educational, and research initiatives to put the "M" back in maternal–fetal medicine.
(Obstet Gynecol 2010;116:1401–4)

Twenty-five years ago, in a seminal article published in the *Lancet*, Allen Rosenfield and Deborah Maine alerted the public to the tremendous problem of global maternal mortality.[1] Recognizing that maternal–child health care programs in developing countries were doing little to reduce maternal mortality and improve maternal health, this commentary was a call to action for health professionals, policy makers, and politicians to focus on this critical issue. Soon thereafter, the international movement to reduce maternal mortality was launched at the global Safe Motherhood Conference in Nairobi, Kenya. Finally, the international community acknowledged the importance of maternal health in the broader context of women's rights and equality and committed resources to decreasing maternal mortality. More recently, reduction in maternal mortality became one of the eight Millennium Development Goals of the United Nations.[2]

There has been good news this year in the progress toward the Millennium Development Goals of the United Nations, which targets a reduction in the maternal mortality ratio by 75% from 1990 to 2015. In a comprehensive analysis funded by the Bill and Melinda Gates Foundation, estimates of global maternal deaths have declined from 526,300 in 1980 to 342,900 in 2008.[3] Maternal mortality is difficult to measure, particularly in developing countries; thus, there are wide uncertainty intervals around these numbers. Nevertheless, these new estimates provide hope that interventions to reduce fertility rates, increase income and education, and expand access to skilled birthing attendants, among other efforts, may be producing the desired results. Because only a minority of countries is currently on track to meet the Millennium Development Goals of the United Nations, it is imperative that the global health community remains fully committed to this goal. At this year's Women Deliver conference, Melinda Gates pledged $1.5 billion toward maternal, newborn, and child health in developing countries over the next 5 years, the second largest donation in the foundation's history. This money not only will enormously help countries with the highest rates of maternal mortality but also it may prompt governments and organizations worldwide to invest more toward maternal health.

In contrast to the generally encouraging trend regarding global maternal mortality, there has been an apparent increase in the maternal mortality ratio in several high-income countries, such as the United States, Canada, Denmark, and Norway.[2] This is not the first evidence that maternal mortality is increasing in the United States. The National Center for Health Statistics has reported that the maternal mortality ratio increased by 62% between 1990 and 2006, from 8.2 to 13.3 per 100,000.[4] These increases have been largely attributed to methodological changes in the

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National Focus

The Joint Commission

Sentinel Event Alert

January 26, 2010

Issue 44, January 26, 2010

Preventing Maternal Death

The goal of all labor and delivery units is a safe birth for both newborn and mother. A previous *Alert*(1) reviewed the causes of death and injury among newborns with normal birth weight and suggested risk reduction strategies. This Alert addresses the equally tragic loss of mothers. Unfortunately, current trends and evidence suggest that maternal mortality rates may be increasing in the U.S., despite the rarity of the incidence of maternal death – deaths that occur within 42 days of birth or termination of pregnancy. Since 1996, a total of 84 cases of maternal death have been reported to The Joint Commission's sentinel event database, with the largest numbers of events reported in 2004, 2005 and 2006. According to the National Center for Health Statistics of the Centers for Disease Control and Prevention, in 2006, the national maternal mortality rate was 13.3 deaths per 100,000 live births. (2) "Although the current maternal mortality rate may reflect increased identification of women who died during or shortly after pregnancy (3), there clearly has been no decrease in maternal mortality in recent years, and we are not moving toward the U.S. government's Healthy People 2010 target of no more than 3.3 maternal deaths per 100,000 live births (4)," says William M. Callaghan, M.D., M.P.H., senior scientist, Division of Reproductive Health, Centers for Disease Control and Prevention.

Leading causes and prevention of maternal death

According to a study by the CDC of pregnancy-related mortality in the U.S. between 1991 and 1997, (5) the leading causes of maternal death are: hemorrhage, hypertensive disorder, pulmonary embolism, amniotic fluid embolism, infection, and pre-existing chronic conditions (such as cardiovascular disease). The study – conducted with state health departments and the American College of Obstetricians and Gynecologists – also indicated a four-fold increased risk of pregnancy-related death for black women, and increased risks for older women and women with no prenatal care. Whether due to better management, increased awareness or quality improvement, the numbers of deaths related to hemorrhage are declining, while deaths attributable to other medical conditions – including cardiovascular, pulmonary and neurologic problems – have significantly increased. (4)

Comment on this *Alert*.

Individual state health departments and researchers nationally are examining the possible role of pre-existing medical conditions in contributing to maternal death. Pre-pregnancy obesity, with its related health implications, is an example. "Obesity is a growing epidemic in this country which impacts all age groups, including women of child-bearing age. Obesity can lead to hypertensive disorders, diabetes, and other medical conditions, and thus can directly and indirectly present significant health risks for pregnant women," says Janet Hardy, Ph.D., M.Sc., M.P.H., perinatal epidemiologist and assistant professor, Departments of Medicine, Obstetrics/Gynecology and Pediatrics, University of Massachusetts Medical School. "Heightened practitioner awareness and screening of pre-pregnant and pregnant women with pre-existing conditions and associated risk factors should be optimized. Improving access to prenatal care environments where specialized services and support are available for these women should be considered." It is only by taking a thorough medical and social history that underlying factors can be revealed.

Attempts to identify preventable deaths and understand how to prevent them has yielded varying results; several studies (6,7,8) determined that from 28 to 50 percent of maternal deaths were preventable. In 2008, Hospital Corporation of America (HCA) looked at individual causes of maternal deaths among 1.5 million births within 124 hospitals in the previous six years. (6) The study concluded that the majority of maternal deaths are not preventable and that while some deaths can be prevented by better individual care, precise figures indicating the frequency of preventable deaths should be examined carefully and with caution. According to the HCA study, the most common preventable errors are:

- Failure to adequately control blood pressure in hypertensive women
- Failure to adequately diagnose and treat pulmonary edema in women with pre-eclampsia
- Failure to pay attention to vital signs following Cesarean section
- Hemorrhage following Cesarean section

"The data showed the individual causes of death to be very heterogeneous and that the only cause of maternal death amendable to nationwide systematic prevention efforts is pulmonary embolism," says Steven L. Clark, M.D., medical

An American Tragedy

50% of Maternal Deaths are Preventable

Sources: D'Alton, et al. National Partnership for Maternal Safety 2014 and California Maternal Quality Care Collaborative

Maternal Mortality

Three Significant Etiologies/Three Opportunities/Three High Value Targets

- Hemorrhage
- Hypertension / Preeclampsia / Eclampsia
- Thromboembolism

Source: National Partnership Maternal Safety. ACOG 2014

Healthcare is a Team Sport

HealthTrust Team Members

- Nursing
- Pharmacy
- Laboratory Medicine
- Physicians
- Administrators

Healthcare is a Team Sport

Maternal mortality and morbidity crisis cannot be fixed by obstetricians alone.

Need your help in your sphere of influence.

Thromboembolism in Pregnancy

The Facts

- Accounts for nearly 10% of all maternal deaths.
- Nearly all (97%) of deaths had at least some chance of preventability.
- 52% had a good to strong chance of preventability.
- Amenable to prevention or effective treatment.
- Most readily implementable means of systemically reducing the maternal death rate.

Sources: *National Partnership For Maternal Safety 2016, CMQCC*

Thromboembolism in Pregnancy

Background

- DVT ≈ 75%
  - More likely on the left side in proximal iliac or iliofemoral vein
- PE ≈ 25%
- 50% during pregnancy
- 50% post-partum

Source: ACOG Practice Bulletin. *Thromboembolism in Pregnancy 2018*

Pregnancy is Thrombogenic

Why?

So mothers don’t exsanguinate during child birth.

Internal physiologic battle
(bleeding vs. clotting)

Thromboembolism in Pregnancy

Virchow's Triad

- Venous Stasis
- Hypercoagulable State
- Endothelial/Vascular Damage

Thromboembolism in Pregnancy

Virchow's Triad - Venous stasis

- Compression of Inferior vena cava and pelvic vessels by enlarging uterus.
- Decreased mobility.
  - Important factor in antepartum complications of preterm labor, placenta previa, incompetent cervix, and prolonged induction of labor.

Virchow's Triad - Hypercoagulability

Changes in the Normal Functioning of the Coagulation System During Pregnancy

Coagulant Factors	Change in Pregnancy
Procoagulants	
Fibrinogen	Increased
Factor VII	Increased
Factor VIII	Increased
Factor X	Increased
Von Willebrand factor	Increased
Plasminogen activator inhibitor-1	Increased
Plasminogen activator inhibitor-2	Increased
Factor II	No change
Factor V	No change
Factor IX	No change
Anticoagulants	
Free Protein S	Decreased
Protein C	No change
Antithrombin III	No change

Sources: ACOG, 2011 Practice Bulletin VOL. 118, NO. 3, SEPTEMBER Thromboembolism in Pregnancy. Bremme, KA. Haemostatic changes in pregnancy. Best Pract Res Clin Haematol. 2203; 16:153-68 and Medcalf, RL, Stasinopoulos, SJ. The undecided serpin. The ins and outs of plasminogen activator inhibitor type 2. FEBS J. 2005 Oct;272(19):4858-67.

Thromboembolism in Pregnancy

Virchow's Triad - Endothelial damage

- Cesarean Section “Surgery is nothing more than organized trauma”.
- Vaginal Delivery
  - Separation of placenta
  - Trauma to birth canal / spontaneous or secondary to operative vaginal delivery (forceps/vacuum).

Thromboembolism in Pregnancy

Risk Factors

- Greatest risk is during the post-partum period (especially the first week).
- Third trimester > 1st or 2nd trimester
- Personal history of clot is most important (↑ risk factor 3 – 4X)
- Thrombophilia
  - Present in 20—50% of women with thromboembolism in pregnancy
  - Includes inherited and acquired thrombophilias

Thromboembolism in Pregnancy

Prophylaxis

- Clinical scenario dictates what standard of care is for antepartum and postpartum management
- EXTREMELY COMPLEX
- Need a clinical tool (Available through ACOG & CMQCC)

Do you have a personal or family history of VTE of Thrombophilia?

Can't remember all this information?

Clinical Scenario	Antepartum Management	Postpartum Management
No history of VTE, no thrombophilia	Surveillance* without anticoagulation therapy	Surveillance without anticoagulation therapy or postpartum prophylactic anticoagulation therapy if the patient has multiple risk factors.†
VTE diagnosed during pregnancy	Adjusted-dose LMWH/UFH	Adjusted-dose LMWH/UFH for a minimum of 6 weeks postpartum. Longer duration of therapy may be indicated depending on the timing of VTE during pregnancy, prior VTE history, or presence of a thrombophilia. Oral anticoagulants may be considered postpartum based upon planned duration of therapy, lactation, and patient preference.
Single provoked VTE (precipitated by a specific event such as surgery, trauma, or immobility) unrelated to estrogen or pregnancy due to a transient (resolved) risk factor, no thrombophilia	Surveillance* without anticoagulation therapy	Surveillance without anticoagulation therapy or postpartum prophylactic anticoagulation therapy if the patient has additional risk factors.†
History of single unprovoked VTE (no identified precipitating factor present; includes prior VTE in pregnancy or associated with hormonal contraception), not on long-term anticoagulation	Prophylactic, intermediate-dose, or adjusted-dose LMWH/UFH	Prophylactic, intermediate-dose, or adjusted-dose LMWH/UFH regimen for 6 weeks postpartum
Low-risk thrombophilia‡ without previous VTE	Surveillance* without anticoagulation therapy	Surveillance without anticoagulation therapy or postpartum prophylactic anticoagulation therapy if the patient has additional risks factors†
Low-risk thrombophilia‡ with a family history (first-degree relative) of VTE	Surveillance* without anticoagulation therapy or prophylactic LMWH/UFH	Postpartum prophylactic anticoagulation therapy or intermediate-dose LMWH/UFH
Low-risk thrombophilia‡ with a single previous episode of VTE—Not receiving long-term anticoagulation therapy	Prophylactic or intermediate-dose LMWH/UFH	Postpartum prophylactic anticoagulation therapy or intermediate-dose LMWH/UFH
High-risk thrombophilia§ without previous VTE	Prophylactic or intermediate-dose LMWH/UFH	Postpartum prophylactic anticoagulation therapy or intermediate-dose LMWH/UFH
High-risk thrombophilia§ with a single previous episode of VTE or an affected first-degree relative—Not receiving long-term anticoagulation therapy	Prophylactic, intermediate-dose, or adjusted-dose LMWH/UFH	Postpartum prophylactic anticoagulation therapy, or intermediate or adjusted-dose LMWH/UFH for 6 weeks (therapy level should be equal to the selected antepartum treatment)
Two or more episodes of VTE—Not receiving long-term anticoagulation therapy (regardless of thrombophilia)	Intermediate-dose or adjusted-dose LMWH/UFH	Postpartum anticoagulation therapy with intermediate-dose or adjusted-dose LMWH/UFH for 6 weeks (therapy level should be equal to the selected antepartum treatment)
Two or more episodes of VTE—Receiving long-term anticoagulation therapy (regardless of thrombophilia)	Adjusted-dose LMWH or UFH	Resumption of long-term anticoagulation therapy. Oral anticoagulants may be considered postpartum based upon planned duration of therapy, lactation, and patient preference.

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

*VTE risk assessment should be performed prepregnancy or early in pregnancy and repeated if complications develop, particularly those necessitating hospitalization or prolonged immobility.

†First-degree relative with a history of a thrombotic episode, or other major thrombotic risk factors (eg, obesity, prolonged immobility, cesarean delivery).

‡Low-risk thrombophilia: Factor V Leiden heterozygote; prothrombin G20210A mutation heterozygote; protein C or protein S deficiency, antiphospholipid antibody.

§High-risk thrombophilias include Factor V Leiden homozygosity, prothrombin gene G20210A mutation homozygosity, heterozygosity for factor V Leiden and prothrombin G20210A mutation, or antithrombin deficiency.

You don't have to!

Source: VOL. 132, NO. 1, JULY 2018 Practice Bulletin Thromboembolism in Pregnancy ACOG

2018 ACOG Practice Bulletin Thromboembolism in Pregnancy

Anticoagulation Regimen Definitions

Anticoagulation Regimen Definitions

Anticoagulation Regimen	Anticoagulation Dosage
Prophylactic LMWH*	Enoxaparin, 40 mg SC once daily
	Dalteparin, 5,000 units SC once daily
	Tinzaparin, 4,500 units SC once daily
	Nadroparin, 2,850 units SC once daily
Intermediate-dose LMWH	Enoxaparin, 40 mg SC every 12 hours
	Dalteparin, 5,000 units SC every 12 hours
Adjusted-dose (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
	Target an anti-Xa level in the therapeutic range of 0.6–1.0 units/mL 4 hours after last injection for twice-daily regimen; slightly higher doses may be needed for a once-daily regimen.
Prophylactic UFH	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
Adjusted-dose (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 × control) 6 hours after injection
Postpartum anticoagulation	Prophylactic, intermediate, or adjusted dose LMWH for 6–8 weeks as indicated. Oral anticoagulants may be considered postpartum based upon planned duration of therapy, lactation, and patient preference.
Surveillance	Clinical vigilance and appropriate objective investigation of women with symptoms suspicious of deep vein thrombosis or pulmonary embolism. VTE risk assessment should be performed prepregnancy or early in pregnancy and repeated if complications develop, particularly those necessitating hospitalization or prolonged immobility.

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

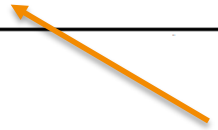
*Although at extremes of body weight, modification of dose may be required.

†Also referred to as weight adjusted, full treatment dose.

Source: VOL. 132, NO. 1, JULY 2018 Practice Bulletin Thromboembolism in Pregnancy ACOG

2018 ACOG Practice Bulletin Thromboembolism in Pregnancy

Clinical Scenario	Antepartum Management	Postpartum Management
No history of VTE, no thrombophilia	Surveillance* without anticoagulation therapy	Surveillance without anticoagulation therapy or postpartum prophylactic anticoagulation therapy if the patient has multiple risk factors.†
VTE diagnosed during pregnancy	Adjusted-dose LMWH/UFH	Adjusted-dose LMWH/UFH for a minimum of 6 weeks postpartum. Longer duration of therapy may be indicated depending on the timing of VTE during pregnancy, prior VTE history, or presence of a thrombophilia. Oral anticoagulants may be considered postpartum based upon planned duration of therapy, lactation, and patient preference.
Single provoked VTE (precipitated by a specific event such as surgery, trauma, or immobility) unrelated to estrogen or pregnancy due to a transient (resolved) risk factor, no thrombophilia	Surveillance* without anticoagulation therapy	Surveillance without anticoagulation therapy or postpartum prophylactic anticoagulation therapy if the patient has additional risk factors.†
History of single unprovoked VTE (no identified precipitating factor present; includes prior VTE in pregnancy or associated with hormonal contraception), not on long-term anticoagulation	Prophylactic, intermediate-dose, or adjusted-dose LMWH/UFH	Prophylactic, intermediate-dose, or adjusted-dose LMWH/UFH regimen for 6 weeks postpartum



Source: VOL. 132, NO. 1, JULY 2018 Practice Bulletin Thromboembolism in Pregnancy ACOG

2018 ACOG Practice Bulletin Thromboembolism in Pregnancy

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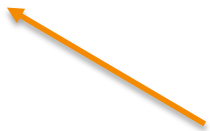
Low-risk thrombophilia‡ with a family history (first-degree relative) of VTE	Surveillance* without anticoagulation therapy or prophylactic LMWH/UFH	Postpartum prophylactic anticoagulation therapy or intermediate-dose LMWH/UFH
Low-risk thrombophilia‡ with a single previous episode of VTE—Not receiving long-term anticoagulation therapy	Prophylactic or intermediate-dose LMWH/UFH	Postpartum prophylactic anticoagulation therapy or intermediate-dose LMWH/UFH



Source: VOL. 132, NO. 1, JULY 2018 Practice Bulletin Thromboembolism in Pregnancy ACOG

2018 ACOG Practice Bulletin Thromboembolism in Pregnancy

Clinical Scenario	Antepartum Management	Postpartum Management
High-risk thrombophilia[§] without previous VTE	Prophylactic or intermediate-dose LMWH/ UFH	Postpartum prophylactic anticoagulation therapy or intermediate-dose LMWH/UFH
High-risk thrombophilia[§] with a single previous episode of VTE or an affected first-degree relative—Not receiving long-term anticoagulation therapy	Prophylactic, intermediate-dose, or adjusted-dose LMWH/UFH	Postpartum prophylactic anticoagulation therapy, or intermediate or adjusted-dose LMWH/UFH for 6 weeks (therapy level should be equal to the selected antepartum treatment)
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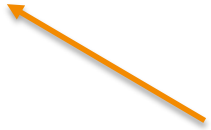


Source: VOL. 132, NO. 1, JULY 2018 Practice Bulletin Thromboembolism in Pregnancy ACOG

Thromboembolism in Pregnancy

Diagnosis - Deep Venous Thrombosis (DVT)

Signs/Symptoms of DVT in Pregnancy Include:

- Calf or thigh pain
- Buttock or back pain (associated with iliac vein thrombosis)
- Erythema
- Edema
- A difference of calf circumference ≥ 2cm suggestive of DVT
- 90% false positive rate

Differential diagnosis

- *Cellulitis*
- *Musculoskeletal Pain*
- *Trauma*
- *Ruptured bakers cyst*
- *Superficial thrombophlebitis*
- *Lymphedema*

Source: *NEJM 2008: 359 2025-33*

DVT Diagnosis

Compression Ultrasound (CUS)
(This is the test of choice)

Order liberally

Sins of omission vs. commission

- *Better to test than miss a life-threatening diagnosis.*

Source: *NEJM 200: 359 2025-33*
- *Clinical Pearl*

Thromboembolism in Pregnancy

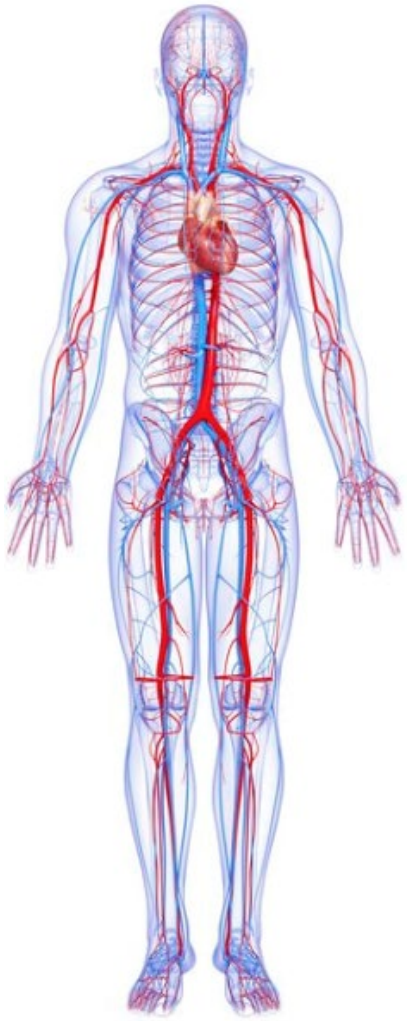
DVT Diagnosis

- If results of CUS are negative or equivocal there may be clot in the iliac vein

- If swelling of the entire leg, flank, buttock, or back pain (classic features of iliac vein thrombosis); Providers need to have a high clinical index of suspicion

- Other ways to diagnose or rule out DVT:
  - Doppler ultrasound iliac vein
  - MRI
  - Contrast venography (rarely used)
  - If index of suspicion remains high consider :
    - Empiric anticoagulation
    - Consult hematology, vascular surgeon

❖ *Always rule out the worst first.*



Source: *Practice Bulletin TIP 2018*
❖ *Clinical Pearl*

Thromboembolism in Pregnancy

Clinical Diagnosis of Pulmonary Embolism

Signs/Symptoms of PE in Pregnancy Include:

- Dyspnea (62%)
- Pleuritic Chest pain (55%)
- Tachycardia (54%)
- Abnormal alveolar arterial oxygen gradient >14 mmHg (41%)
- Cough (24%)
- Diaphoresis (18%)
- Hemoptysis (8%)
- Syncope (5%)

❖ Always address nursing concerns thoroughly and quickly

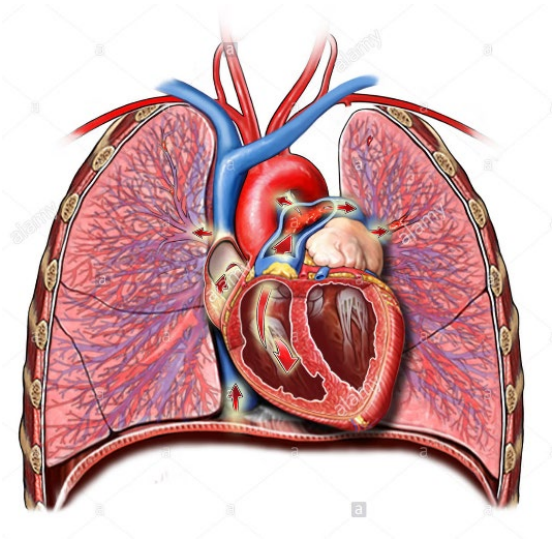
Differential diagnosis

- *Patient says "I just don't feel right".*
- *Have high index of suspicion*
- *Low threshold for diagnostic testing*

Thromboembolism in Pregnancy

Clinical Diagnosis of Pulmonary Embolism

- Chest X-ray is starting point
  - Ventilation-perfusion (VQ) scan
    - if X-ray normal
  - Computed tomography angiography (CTA)
    - if X-ray abnormal
- Both have low radiation exposure to baby
- Missed diagnosis could be catastrophic. (e.g. Fetal Saddle Embolism)



Diagnosis of Suspected Pulmonary Embolism in Pregnancy

Recent Scholarly Articles

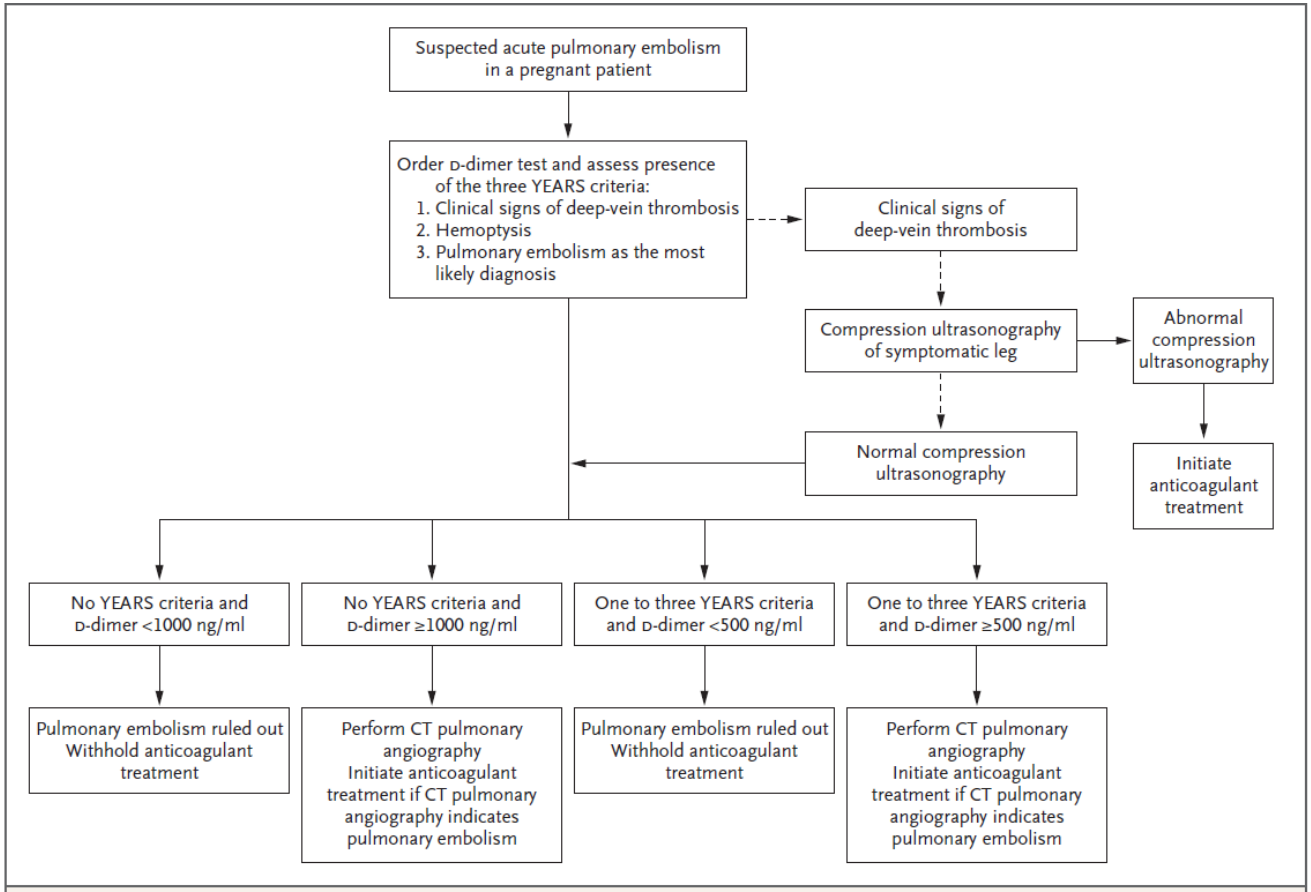


Figure 1. Pregnancy-Adapted YEARS Algorithm for the Management of Suspected Acute Pulmonary Embolism in Pregnant Patients.
CT denotes computed tomography.

Source: "Pregnancy-Adapted YEARS Algorithm for Diagnosis of Suspected Pulmonary Embolism"; L.M. van der Pol, C. Tromeur, I.M. Bistervels, M.V. Huisman, et al., for the Artemis Study Investigators*; N Engl J Med 2019;380:1139-49. DOI: 10.1056/NEJMoa1813865

Thromboembolism in Pregnancy

Treatment of Acute Thromboembolism

- Adjusted dose (therapeutic anticoagulation with heparin compounds).
- Low molecular weight heparin (LMWH) is generally the drug of choice; however, there is more pharmacologic control with unfractionated heparin.
- Low molecular weight heparin (LMWH) associated with fewer bleeding episodes, more predictable therapeutic response, lower risk of heparin induced thrombocytopenia (HIT), longer half-life and less bone mineral loss.
- Initial therapy for at least 3–6 months.
- Clinician should consider moderated intensity of anticoagulation after treatment depending on risk factors.
- Obstetrical patients are a unique patient population.
- “Circle the wagons.”
- Consult liberally with Hematology, Vascular Surgery, Internal Medicine, Pulmonary, Critical Care Medicine, Anesthesia (integral part of plan for delivery).

Source: *ACOG, 2018 Practice Bulletin -Thromboembolism in Pregnancy*

Thromboembolism in Pregnancy

Pulmonary Embolism Treatment

Inferior vena cava filters

- Inferior vena cava (IVC) filters have been used during pregnancy.
  - Indications for insertion of an IVC filter are the same in pregnant and non pregnant patients
- Conventional anticoagulation is contradicted, such as during active bleeding, following recent surgery or following a hemorrhagic stroke
- Conventional anticoagulation has proven ineffective, such as in patients who develop new venous thromboembolism (VTE) despite being anticoagulated.
- A complication of anticoagulation develops (e.g., significant bleeding), which prohibits continuation of anticoagulant therapy.

Source: *Deep vein thrombosis and pulmonary embolism in pregnancy*: Treatment–Up-to-date 2019

Thromboembolism in Pregnancy

Pulmonary Embolism Therapy

Thrombolysis/Thrombectomy

- Teratogenicity due to the thrombolytic agent has not been reported
- Risk of maternal hemorrhage is high.
- Thrombolytic therapy should be reserved for pregnant patients with life-threatening acute pulmonary embolism (i.e., persistent and severe hypotension due to the PE).
- Case reports of thrombectomy suggest that it can be used successfully as a life-saving measure when other measures have failed.

Source: *Deep vein thrombosis and pulmonary embolism in pregnancy*: Treatment–Up-to-date 2019

Treatment

Embryopathic

Sometimes used with mechanical heart valves
(increased risk of clotting even with heparin compounds)

Thromboembolism in Pregnancy

Treatment Regarding New Anticoagulation Medications

- Oral direct thrombin inhibitors (i.e., Bivalirudin, dabigatran) and anti Xa inhibitors (i.e., rivaroxiban, apixaban, fondaparinux.
- Avoid in pregnancy and lactation due to the lack of safety data.

Thromboembolism in Pregnancy

National Partnership for Maternal Safety

Consensus Bundle on Venous Thromboembolism Prevention

- Safety Bundle: straightforward, evidence based recommendations for practice and care processes known to improve outcomes
- Goal is to adopt this safety bundle by every birthing facility in the U.S. (successful adoption must be multidisciplinary to include nursing, pharmacy, laboratory, anesthesia, obstetrics, and administration)
- 4 Action Domains
  - Readiness, Recognition and Prevention, Response, Reporting Systems and Learning

Source: Obstet Gynecol 128: (4) p688; 2016

4 time points

PATIENT SAFETY BUNDLE

Maternal Venous Thromboembolism Prevention

READINESS

Every Unit

- Use a standardized thromboembolism risk assessment tool for VTE during:
  - Outpatient prenatal care
  - Antepartum hospitalization
  - Hospitalization after cesarean or vaginal deliveries
  - Postpartum period (up to 6 weeks after delivery)

RECOGNITION & PREVENTION

Every Patient

- Apply standardized tool to all patients to assess VTE risk at time points designated under "Readiness"
- Apply standardized tool to identify appropriate patients for thromboprophylaxis
- Provide patient education
- Provide all healthcare providers education regarding risk assessment tools and recommended thromboprophylaxis

RESPONSE

Every Unit

- Use standardized recommendations for mechanical thromboprophylaxis
- Use standardized recommendations for dosing of prophylactic and therapeutic pharmacologic anticoagulation
- Use standardized recommendations for appropriate timing of pharmacologic prophylaxis with neuraxial anesthesia

REPORTING/SYSTEMS LEARNING

Every Unit

- Review all thromboembolism events for systems issues and compliance with protocols
- Monitor process metrics and outcomes in a standardized fashion
- Assess for complications of pharmacologic thromboprophylaxis

Standardization of health care processes and reduced variation has been shown to improve outcomes and quality of care. The Council on Patient Safety in Women's Health Care disseminates patient safety bundles to help facilitate the standardization process. This bundle reflects emerging clinical, scientific, and patient safety advances as of the date issued and is subject to change. The information should not be construed as dictating an exclusive course of treatment or procedure to be followed. Although the components of a particular bundle may be adapted to local resources, standardization within an institution is strongly encouraged.

The Council on Patient Safety in Women's Health Care is a broad consortium of organizations across the spectrum of women's health for the promotion of safe health care for every woman.

October 2015

For more information visit the Council's website at www.safehealthcareforeverywoman.org

Thromboembolism in Pregnancy

READINESS

Every Unit

- Use a standardized thromboembolism risk assessment tool for VTE during:
  - Outpatient prenatal care (ACOG Practice Bulletin Thromboembolism 2018)
  - Antepartum hospitalization
  - Hospitalization after cesarean or vaginal deliveries (Birth Hospitalization)
  - Postpartum period (up to 6 weeks after delivery) (ACOG Practice Bulletin Thromboembolism 2018)

4 time points

Out-Patient Prenatal Care (First time point)

Do you have a personal or family history of VTE or thrombophilia?

Clinical Scenario	Antepartum Management	Postpartum Management
No history of VTE, no thrombophilia	Surveillance* without anticoagulation therapy	Surveillance without anticoagulation therapy or postpartum prophylactic anticoagulation therapy if the patient has multiple risk factors.†
VTE diagnosed during pregnancy	Adjusted-dose LMWH/UFH	Adjusted-dose LMWH/UFH for a minimum of 6 weeks postpartum. Longer duration of therapy may be indicated depending on the timing of VTE during pregnancy, prior VTE history, or presence of a thrombophilia. Oral anticoagulants may be considered postpartum based upon planned duration of therapy, lactation, and patient preference.
Single provoked VTE (precipitated by a specific event such as surgery, trauma, or immobility) unrelated to estrogen or pregnancy due to a transient (resolved) risk factor, no thrombophilia	Surveillance* without anticoagulation therapy	Surveillance without anticoagulation therapy or postpartum prophylactic anticoagulation therapy if the patient has additional risk factors.†
History of single unprovoked VTE (no identified precipitating factor present; includes prior VTE in pregnancy or associated with hormonal contraception), not on long-term anticoagulation	Prophylactic, intermediate-dose, or adjusted-dose LMWH/UFH	Prophylactic, intermediate-dose, or adjusted-dose LMWH/UFH regimen for 6 weeks postpartum
Low-risk thrombophilia‡ without previous VTE	Surveillance* without anticoagulation therapy	Surveillance without anticoagulation therapy or postpartum prophylactic anticoagulation therapy if the patient has additional risks factors†
Low-risk thrombophilia‡ with a family history (first-degree relative) of VTE	Surveillance* without anticoagulation therapy or prophylactic LMWH/UFH	Postpartum prophylactic anticoagulation therapy or intermediate-dose LMWH/UFH
Low-risk thrombophilia‡ with a single previous episode of VTE—Not receiving long-term anticoagulation therapy	Prophylactic or intermediate-dose LMWH/UFH	Postpartum prophylactic anticoagulation therapy or intermediate-dose LMWH/UFH
High-risk thrombophilia§ without previous VTE	Prophylactic or intermediate-dose LMWH/UFH	Postpartum prophylactic anticoagulation therapy or intermediate-dose LMWH/UFH
High-risk thrombophilia§ with a single previous episode of VTE or an affected first-degree relative—Not receiving long-term anticoagulation therapy	Prophylactic, intermediate-dose, or adjusted-dose LMWH/UFH	Postpartum prophylactic anticoagulation therapy, or intermediate or adjusted-dose LMWH/UFH for 6 weeks (therapy level should be equal to the selected antepartum treatment)
Two or more episodes of VTE—Not receiving long-term anticoagulation therapy (regardless of thrombophilia)	Intermediate-dose or adjusted-dose LMWH/UFH	Postpartum anticoagulation therapy with intermediate-dose or adjusted-dose LMWH/UFH for 6 weeks (therapy level should be equal to the selected antepartum treatment)
Two or more episodes of VTE—Receiving long-term anticoagulation therapy (regardless of thrombophilia)	Adjusted-dose LMWH or UFH	Resumption of long-term anticoagulation therapy. Oral anticoagulants may be considered postpartum based upon planned duration of therapy, lactation, and patient preference.

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

*VTE risk assessment should be performed prepregnancy or early in pregnancy and repeated if complications develop, particularly those necessitating hospitalization or prolonged immobility.

†First-degree relative with a history of a thrombotic episode, or other major thrombotic risk factors (eg, obesity, prolonged immobility, cesarean delivery).

‡Low-risk thrombophilia: Factor V Leiden heterozygote; prothrombin G20210A mutation heterozygote; protein C or protein S deficiency, antiphospholipid antibody.

§High-risk thrombophilias include Factor V Leiden homozygosity, prothrombin gene G20210A mutation homozygosity, heterozygosity for factor V Leiden and prothrombin G20210A mutation, or antithrombin deficiency.

Source: VOL. 132, NO. 1, JULY 2018, Practice Bulletin Thromboembolism in Pregnancy ACOG

Thromboembolism in Pregnancy

READINESS

Every Unit

- Use a standardized thromboembolism risk assessment tool for VTE during:
  - Outpatient prenatal care (ACOG Practice Bulletin Thromboembolism 2018)
  - Antepartum hospitalization
  - Hospitalization after cesarean or vaginal deliveries (Birth Hospitalization)
  - Postpartum period (up to 6 weeks after delivery) (ACOG Practice Bulletin Thromboembolism 2018)

2 time points

Editorial

Peripartum Venous Thromboembolism Prophylaxis

Where Do We Go From Here?

Steven L. Clark, MD

The issue of peripartum venous thromboembolism prevention has plagued pregnant women and their physicians for decades. In an absolute sense, clinical venous thromboembolism is less common in young, healthy, peripartum women than in other classes of medical or surgical patients. On the other hand, pulmonary embolism is a major cause of potentially preventable maternal mortality. A paucity of data regarding efficacy of any prophylactic measures in this specific population, coupled with cost-benefit concerns, have allowed these questions to persist.

An important first step in resolving this dilemma was an analysis in 2006 by Cassale and Grobman supporting the cost-effectiveness of a policy of universal venous thromboembolism prophylaxis in women undergoing cesarean delivery.[1] This was followed in 2007 by a decision by the Hospital Corporation of America, the nation's largest provider of delivery services, to institute a policy of universal perioperative prophylaxis using pneumatic compression in all women undergoing cesarean delivery, based on a review of maternal deaths in more than 1 million deliveries.[2] In 2011, this approach was formally adopted by the American College of Obstetricians and Gynecologists and was validated in a 2014 report demonstrating a significant reduction in deaths from postcesarean pulmonary embolism after the introduction of such a policy.[2]

It is thus with some concern that one reads the report by Brady et al[3] in this issue of *Obstetrics & Gynecology* (see page 19). In a study of 228 women undergoing cesarean delivery or benign gynecologic surgery in whom the use of compression devices was ordered, the authors demonstrated compliance rates barely exceeding 50%; compliance was also inversely correlated with length of stay. In addition, the authors found a targeted program of nursing and patient education ineffective in improving compliance. The authors' findings, while reflecting unfavorably on nursing and patient compliance with orders, are actually less worrisome with respect to actual patient safety. Most deep venous clots resulting in embolism are felt to arise during surgery while the patient is immobile; this may be particularly true for cesarean delivery given the known venous pooling associated with spinal anesthesia. Further, unlike patients undergoing many other types of general, orthopedic, and neurologic surgeries, postcesarean patients generally do not experience prolonged postoperative immobility–most are fully ambulatory within 12–24 hours. Current average lengths of stay for women undergoing either vaginal or cesarean delivery are largely a product of non–evidence-based legislative fiat rather than medical necessity, and thus do not accurately reflect duration of postprocedure immobility.[4] The authors' finding of 70% compliance with prophylaxis on day 0 and their observations regarding reasons for noncompliance imply much more frequent intraoperative use of

See related article on page 19.

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Pulmonary embolism is a major cause of potentially preventable maternal mortality.

There may be a benefit in applying risk estimates and treatment approaches derived from well-established risk assessment models (e.g., a modified Padua system) to pregnant patients for whom prolonged hospitalization is anticipated.

The issue of peripartum venous thromboembolism prophylaxis has been neglected long enough. Our patients cannot afford to wait while we reinvent a specialty-specific wheel.

TABLE 1. Padua Prediction Score[a,b]

Risk factor	Points
Active cancer[c]	3
Previous VTE (with the exclusion of superficial vein thrombosis)	3
Reduced mobility[d]	3
Already known thrombophilic condition[e]	3
Recent (≤1 mo) trauma and/or surgery	2
Elderly age (≥70 y)	1
Heart and/or respiratory failure	1
Acute myocardial infarction or ischemic stroke	1
Acute infection and/or rheumatologic disorder	1
Obesity (BMI ≥30)	1
Ongoing hormonal treatment	1

[a]BMI = body mass index; VTE = venous thromboembolism.
[b]In the Padua Prediction Score risk assessment model, high risk of VTE is defined by a cumulative score of ≥4 points.
[c]Patients with local or distant metastases and/or in whom chemotherapy or radiotherapy had been performed in the previous 6 mo.
[d]Anticipated bed rest with bathroom privileges (either because of patient's limitations or on physician's order) for at least 3 d.
[e]Carriage of defects of antithrombin, protein C or S, factor V Leiden, G20210A prothrombin mutation, antiphospholipid syndrome.

Source: *Mayo Clinic Proceedings · December 2017*

Thromboembolism in Pregnancy

- *Keep patients hydrated. Thick blood is more likely to clot.*
- *Walking protocol (e.g., ambulate every hour when awake).*

RECOGNITION & PREVENTION

Every Patient

- Apply standardized tool to all patients to assess VTE risk at time points designated under "Readiness"
- Apply standardized tool to identify appropriate patients for thromboprophylaxis ***(use the tool)***
- Provide patient education
- Provide all healthcare providers education regarding risk assessment tools and recommended thromboprophylaxis

- *Clinical Pearl*

Thromboembolism in Pregnancy: RCOG Guidelines

Box 2. Royal College of Obstetricians and Gynaecologists Recommendations for Antenatal and Postpartum Venous Thromboembolism Prophylaxis

Clinical recommendations for thromboprophylaxis with low molecular weight heparin

If total score ≥4 antenatally, consider thromboprophylaxis from the first trimester
If total score 3 antenatally, consider thromboprophylaxis from 28 weeks
If total score ≥2 postnatally, consider thromboprophylaxis for at least 10 days
If admitted to hospital antenatally consider thromboprophylaxis
If prolonged admission (≥3 days) or readmission to hospital within the puerperium consider thromboprophylaxis

Scoring system

4 points
- Previous venous thromboembolism (except for a single event related to major surgery)
- Ovarian hyperstimulation syndrome (first trimester only)

3 points
- Previous venous thromboembolism provoked by major surgery
- Known high-risk thrombophilia
- * Any surgical procedure in pregnancy or puerperium except immediate repair of the perineum, eg, appendectomy, postpartum sterilization
- Hyperemesis
- Medical comorbidities, eg, cancer, heart failure, active systemic lupus erythematosus, inflammatory polyarthropathy or inflammatory bowel disease, nephrotic syndrome, type I diabetes mellitus with nephropathy, sickle cell disease, current intravenous drug user

2 points
- Cesarean in labor
- Obesity (BMI >40 kg/m²)

1 point
- Family history of unprovoked or estrogen-related venous thromboembolism in first-degree relative
- Known low-risk thrombophilia (no venous thromboembolism history)
- Age (>35 years)
- Obesity (BMI >30 kg/m²)
- Parity ≥3
- Smoker
- Gross varicose veins
- Preeclampsia in current pregnancy
- Assisted reproductive technology, in vitro fertilization (antenatal only)
- Multiple pregnancy
- Elective cesarean
- Mid-cavity rotational operative birth
- Prolonged labor (>24 hours)
- Postpartum hemorrhage (>1 liter or blood transfusion)
- Preterm birth <37 weeks in current pregnancy
- Stillbirth in current pregnancy
- Current systemic infection
- Immobility, dehydration

BMI, body mass index.

Reproduced from: Royal College of Obstetricians and Gynaecologists. Reducing the Risk of Venous Thromboembolism during Pregnancy and the Puerperium. Green-top Guideline No. 37a. London: RCOG; 2015, with the permission of the Royal College of Obstetricians and Gynaecologists.

- *Clinical Pearl*

* Consideration for the addition of postpartum hemorrhage requiring transfusion, hysterectomy, D&C or interventional radiology procedure as a major risk factor (must weigh risks/benefits).

VTE Prophylaxis Assessment
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Patient Label

VTE Prophylaxis Assessment — *To be completed by Nurse*

This is to be completed on admission, upon transfer to Postpartum, and as needed based on patient course of care.

Please check the boxes as they are applicable to the patient and sum total Risk Factor Points based on patient history.

Antepartum Admission Assessment

Risk Factors	Points
☐ Immobility (bed rest greater than 3 days antepartum)**	4
☐ High risk Thrombophilia* (antithrombin deficiency; double heterozygous for prothrombin G20210A mutation and factor V Leiden; factor V Leiden homozygous or prothrombin G20210A mutation homozygous)	4
☐ Previous VTE	4
☐ Active cancer	4
☐ Medical condition (SLE, Sickle cell disease, heart disease)	2
☐ Active infection (e.g. chorio, endometritis, pyelo, etc.)	2
☐ BMI greater than or equal to 35 kg/m²	2
☐ History of cancer (treated in past year)	2
☐ Low risk Thrombophilia* (factor V Leiden heterozygous; prothrombin G20210A heterozygous; protein C or protein S deficiency)	2
☐ Age greater than 40 years and above	2
☐ Multiple pregnancy	2
☐ Smoker (greater than 10 cigarettes/day)	2

Total Points: _____

IF Total Points are greater than or equal to 4, and/or the patient has Thrombophilia notify provider immediately for prophylaxis!
***Refer to ACOG Bulletin Inherited Thrombophilias in Pregnancy #138**
****Hold for those at risk for immediate hemorrhage risk, such as placenta previa**

Provider notified: _____

Date/Time notified: _____

Assessment completed by: _____

Date/Time completed: _____

Post-Delivery Transfer Assessment

Risk Factors	Points
☐ Immobility (bed rest greater than 3 days antepartum)**	4
☐ High risk Thrombophilia* (antithrombin deficiency; double heterozygous for prothrombin G20210A mutation and factor V Leiden; factor V Leiden homozygous or prothrombin G20210A mutation homozygous)	4
☐ Previous VTE	4
☐ Active cancer	4
☐ Medical condition (SLE, Sickle cell disease, heart disease)	2
☐ Active infection (e.g. chorio, endometritis, pyelo, etc.)	2
☐ BMI greater than or equal to 35 kg/m²	2
☐ History of cancer (treated in past year)	2
☐ Low risk Thrombophilia* (factor V Leiden heterozygous; prothrombin G20210A heterozygous; protein C or protein S deficiency)	2
☐ Age greater than 40 years and above	2
☐ Multiple pregnancy	2
☐ Smoker (greater than 10 cigarettes/day)	2
☐ Cesarean Section	2

Total Points: _____

IF Total Points are greater than or equal to 4, and/or the patient has Thrombophilia notify provider immediately for prophylaxis!
***Refer to ACOG Bulletin Inherited Thrombophilias in Pregnancy #138**
****Hold for those at risk for immediate hemorrhage risk, such as placenta previa**

Provider notified: _____

Date/Time notified: _____

Assessment completed by: _____

Date/Time completed: _____

*Sources: CMQCC,RCOG

VTE Prophylaxis Assessment
Not Part of the Medical Record
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Patient Label

For Provider Use	Patient is _____ weeks pregnant / Patient is in the _____ trimester / The patient's VTE Prophylaxis Assessment score is _____

VTE Prophylaxis Exclusion Criteria *(if no prophylaxis is ordered, reason must be specified)*

- Therapeutic on Home Anticoagulation Therapy: Continue therapeutic therapy and send order to pharmacy
- Patient needs TREATMENT dosing:
  - Consult Hematology
  - Consult and send order to Pharmacy
- Low Risk for VTE: Pharmacologic Prophylaxis not indicated
- Contraindications to Pharmacologic Prophylaxis:
  - Allergy to Heparin products
  - Active Bleed
  - Active Stroke in previous 4 weeks
  - Thrombocytopenia
  - Increased risk of major hemorrhage
  - Other: _____
- Contraindications to Mechanical Prophylaxis
  - Injury to Lower Extremities
  - Other _____

Recommended ANTEPARTUM Prophylaxis Dosing *(switch to Heparin Sodium if gestation greater than or equal to* 36 weeks

Enoxaparin (Lovenox®)

- BMI less than 40 kg/m2: Enoxaparin 40mg subcutaneous every 24 hours
- BMI greater than 40 kg/m2: Enoxaparin 40mg subcutaneous every 12 hours

Unfractionated Heparin (Heparin Sodium®)

- 1st Trimester: Heparin 5.000 units subcutaneous every 12 hours
- 2nd Trimester: Heparin 7,500 units subcutaneous every 12 hours
- 3rd Trimester: Heparin 10,000 units subcutaneous every 12 hours

Holding of Pharmacologic Therapy *BEFORE* Neuroaxial Anesthesia

Medication	Wait time post last dose prior to neuraxial blockade
Unfractionated Heparin Prophylaxis	**8 hours**
Unfractionated Heparin Therapeutic	**8 hours**
Enoxaparin Prophylaxis	**12 hours**
Enoxaparin Therapeutic	**24 hours**

Recommended POSTPARTUM Prophylaxis Dosing *(Starting at: Date: _____ Time: _____)*

Enoxaparin (Lovenox®)

- BMI less than 40 kg/m2: Enoxaparin 40mg subcutaneous every 24 hours
- BMI greater than 40 kg/m2: Enoxaparin 40mg subcutaneous every 12 hours

Unfractionated Heparin (Heparin Sodium®)

Heparin 5,000 units subcutaneous every 12 hours

Mechanical Prophylaxis

- Apply sequential compression device: Routine, UNTIL DISCONTINUED

Laboratory Orders

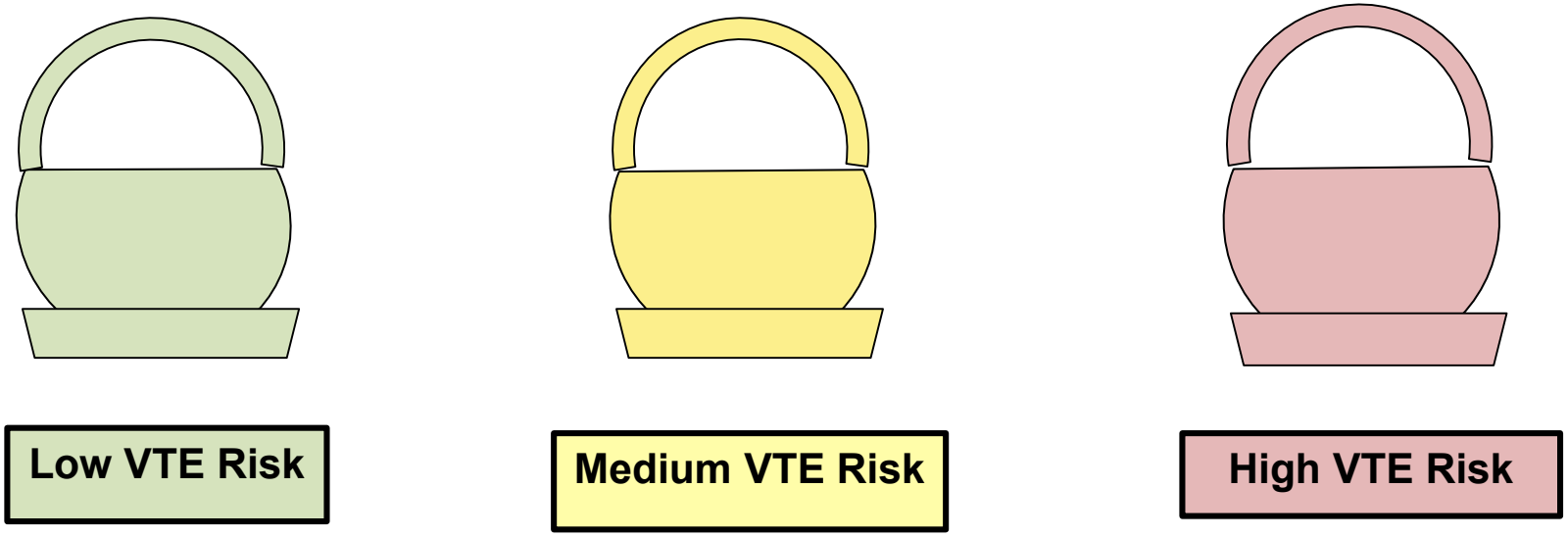
- CBC and SCr at baseline and routinely

Re-Starting Pharmacologic Therapy *AFTER* Neuroaxial Anesthesia

Medication	Wait time after epidural catheter removal or spinal needle placement
Unfractionated Heparin Prophylaxis (less than 10,000IU/day)	**Greater than 2 hours**
Unfractionated Heparin Therapeutic	**Greater than 2 hours**
Enoxaparin Prophylaxis	**Greater than 4 hours**
Enoxaparin Therapeutic	**Greater than 24 hours**

3 Levels of VTE Risk

Utilize the “3 bucket model” risk assessment that stratifies VTE risk in pregnant or postpartum women into three color-coded levels for rapid identification



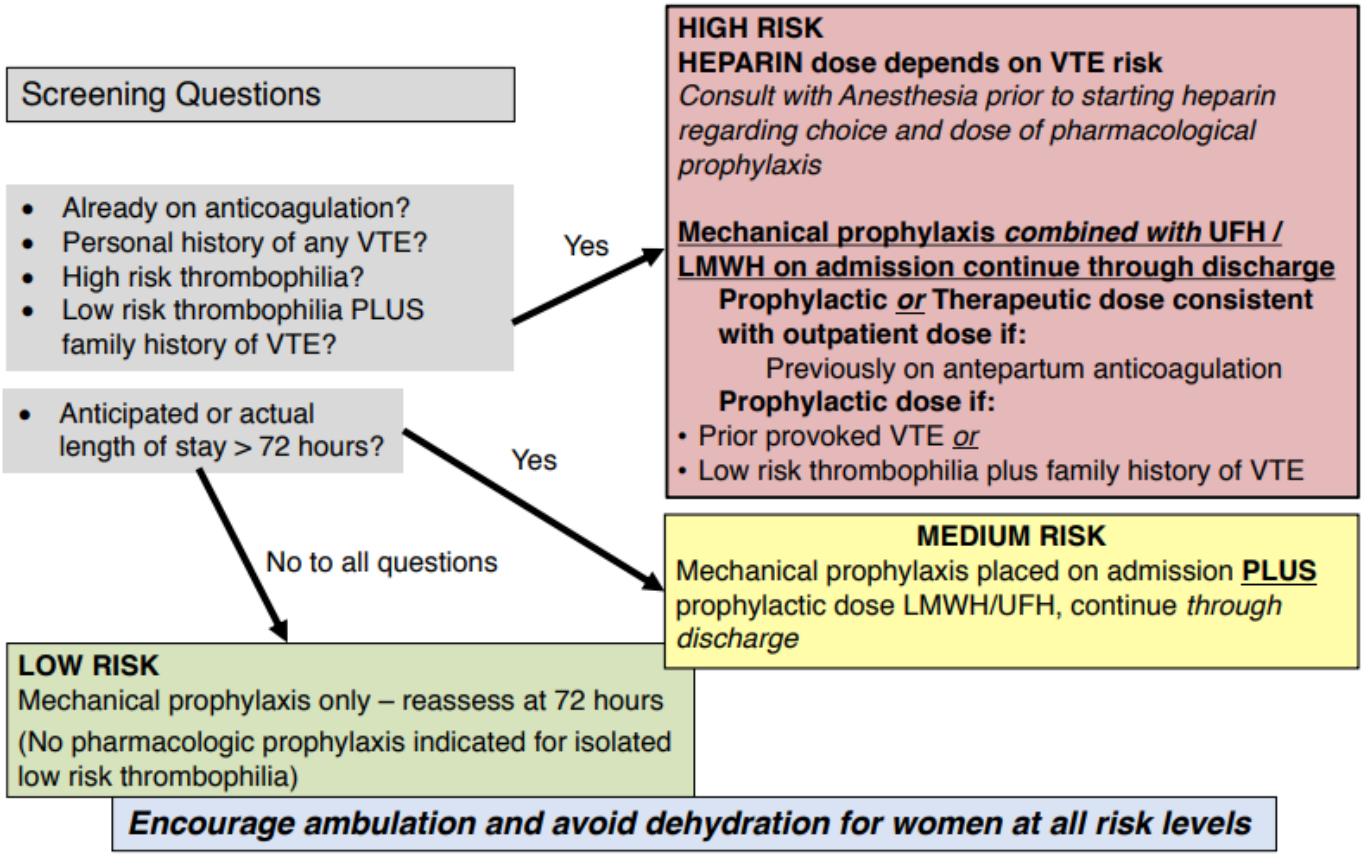
Source: Hameed AB, Montgomery D, Peterson N, Morton CH, and A Friedman. Improving Health Care Response to Maternal Venous Thromboembolism. Developed under contract #11-10006 with the California Department of Public Health, Maternal, Child and Adolescent Health Division. Published by the California Department of Public Health, 2017.

Table 5: Antepartum Hospital Admission VTE Risk Assessment

Clinical History	Risk Level	Anticoagulation
Encourage ambulation and avoid dehydration at all risk levels		
All patients not in high risk category with anticipated admission < 72 hours	**LOW**	Mechanical prophylaxis placed on admission continue through discharge Reassess at 72 hours
All patients admitted not in high risk category with anticipated or actual length of stay ≥ 72 hours	**MEDIUM**	Mechanical prophylaxis placed on admission continue through discharge **PLUS** Prophylactic-dose LMWH or UFH in collaboration with anesthesia
High risk or Antiphospholipid Syndrome (APS), with no prior VTE, regardless of family history Prior provoked, idiopathic, or estrogen related VTE Low risk thrombophilia **AND** family history of VTE **OR** single prior VTE **OR** Patients already receiving LMWH or UFH as outpatient Multiple prior VTE episodes Prior VTE and high risk or APS	**HIGH**	*Mechanical prophylaxis placed on admission continue through discharge* **PLUS** Prophylactic dose LMWH / UFH in collaboration with anesthesia **OR** *Mechanical prophylaxis placed on admission continue through discharge* **PLUS** Prophylactic ***or*** Therapeutic dose LMWH / UFH consistent with antepartum dosing in collaboration with anesthesia

Algorithm 2: Antepartum Hospital Admission: Maternal VTE Risk Assessment

Please see Definitions for elaboration of key terms and dosages or page 19.



Cesarean Birth
Major and Minor VTE Risk Factors

MAJOR VTE RISK FACTORS	MINOR VTE RISK FACTORS
▪ **BMI > 35 kg/m2** @ delivery ▪ **Low risk thrombophilia** ▪ **Postpartum hemorrhage requiring**: Transfusion or further operation, (e.g. hysterectomy, D&C) or Interventional Radiology procedure ▪ **Infection requiring antibiotics** ▪ **Antepartum hospitalization ≥ 72 hours**, current or within the last month ▪ **Chronic medical conditions**: Sickle Cell disease, Systemic Lupus Erythematosus, Significant Cardiac disease, active Inflammatory Bowel Disease, active cancer, Nephrotic syndrome	▪ Multiple gestation ▪ Age > 40 ▪ Postpartum hemorrhage ≥1000 ml but ***not requiring:*** Transfusion or further operation, (e.g. hysterectomy, D&C) or Interventional Radiology procedure ▪ Family history of VTE (VTE occurring in a first-degree relative prior to age 50) ▪ Smoker ▪ Preeclampsia

Women with one major or two minor risk factors should receive in-hospital post cesarean pharmacologic prophylaxis

Role of obesity : 61% of women who died from VTE had a delivery BMI ≥ 35.

Table 7: Cesarean Birth VTE Risk Assessment and Suggested Prophylaxis

Clinical History	Risk Level	Prophylaxis Regimen
Encourage ambulation and avoid dehydration at all risk levels. All women having cesarean birth receive mechanical prophylaxis.		
Not meeting medium or high risk criteria	**LOW**	Mechanical prophylaxis placed prior to cesarean and continued until fully ambulatory
Cesarean Delivery with 1 Major ***or*** **≥ 2** Minor Risk Factors (See Table 6)	**MEDIUM**	Mechanical prophylaxis placed prior to cesarean and continued until fully ambulatory **PLUS** Prophylactic dose LMWH / UFH postpartum, continue until discharge
High risk thrombophilia (including acquired) no prior VTE, regardless of family history Prior provoked, idiopathic, or estrogen related VTE Low risk thrombophilia **AND** family history of VTE **OR** single prior VTE Patients already receiving LMWH or UFH as outpatient Multiple prior VTE Prior VTE with High Risk thrombophilia (including APS)	**HIGH**	Mechanical prophylaxis placed prior to cesarean and continued until fully ambulatory **PLUS** Prophylactic dose LMWH / UFH in hospital and continued until 6 weeks from date of delivery Mechanical prophylaxis placed prior to cesarean and continued until fully ambulatory **PLUS** Therapeutic dose LMWH / UFH postpartum (Postpartum dose ≥ Antepartum dose) in hospital and continued until 6 weeks from delivery date after discharge

Table 8: Vaginal Birth VTE Risk Assessment and Suggested Prophylaxis

Clinical History	Risk Level	Anticoagulation
Encourage ambulation and avoid dehydration at all risk levels		
Delivery BMI ≥ 40 kg/m^2	**LOW**	Mechanical prophylaxis placed prior to delivery and continued until fully ambulatory
Delivery BMI ≥ 40 kg/m^2 **PLUS** Antepartum hospitalization ≥ 72 hours anticipated currently or within past month **OR** **Delivery BMI ≥ 40 kg/m^2 PLUS** Low Risk Thrombophilia	**MEDIUM**	Mechanical prophylaxis placed prior to delivery and continued until fully ambulatory **PLUS** Prophylactic dose LMWH / UFH postpartum hospitalization **BMI ≥ 40 kg/m^2 plus thrombophilia** (consider LMWH/UFH continuation 6 weeks postpartum)
High risk thrombophilia with no prior VTE regardless of family history Prior provoked, idiopathic, or estrogen related VTE Low risk thrombophilia **AND** family history of VTE *ANY* single prior VTE **OR** Patients already receiving LMWH or UFH as outpatient Multiple prior VTE Prior VTE with High Risk or Antiphospholipid Syndrome (APS)	**HIGH**	Mechanical prophylaxis placed prior to delivery and continued until fully ambulatory **PLUS** Prophylactic dose LMWH / UFH postpartum in hospital and **continued until 6 weeks from date of delivery after discharge** **OR** Mechanical prophylaxis placed prior to delivery and continued until fully ambulatory **PLUS** Therapeutic dose LMWH / UFH postpartum **(Postpartum dose ≥ Antepartum dose)** in hospital and **continued until 6 weeks from date of delivery after *discharge***

Postpartum period (Fourth Time Point)

Do you have a personal or family history of VTE or thrombophilia?

Clinical Scenario	Antepartum Management	Postpartum Management
No history of VTE, no thrombophilia	Surveillance* without anticoagulation therapy	Surveillance without anticoagulation therapy or postpartum prophylactic anticoagulation therapy if the patient has multiple risk factors.†
VTE diagnosed during pregnancy	Adjusted-dose LMWH/UFH	Adjusted-dose LMWH/UFH for a minimum of 6 weeks postpartum. Longer duration of therapy may be indicated depending on the timing of VTE during pregnancy, prior VTE history, or presence of a thrombophilia. Oral anticoagulants may be considered postpartum based upon planned duration of therapy, lactation, and patient preference.
Single provoked VTE (precipitated by a specific event such as surgery, trauma, or immobility) unrelated to estrogen or pregnancy due to a transient (resolved) risk factor, no thrombophilia	Surveillance* without anticoagulation therapy	Surveillance without anticoagulation therapy or postpartum prophylactic anticoagulation therapy if the patient has additional risk factors.†
History of single unprovoked VTE (no identified precipitating factor present; includes prior VTE in pregnancy or associated with hormonal contraception), not on long-term anticoagulation	Prophylactic, intermediate-dose, or adjusted-dose LMWH/UFH	Prophylactic, intermediate-dose, or adjusted-dose LMWH/UFH regimen for 6 weeks postpartum
Low-risk thrombophilia‡ without previous VTE	Surveillance* without anticoagulation therapy	Surveillance without anticoagulation therapy or postpartum prophylactic anticoagulation therapy if the patient has additional risks factors†
Low-risk thrombophilia‡ with a family history (first-degree relative) of VTE	Surveillance* without anticoagulation therapy or prophylactic LMWH/UFH	Postpartum prophylactic anticoagulation therapy or intermediate-dose LMWH/UFH
Low-risk thrombophilia‡ with a single previous episode of VTE—Not receiving long-term anticoagulation therapy	Prophylactic or intermediate-dose LMWH/UFH	Postpartum prophylactic anticoagulation therapy or intermediate-dose LMWH/UFH
High-risk thrombophilia§ without previous VTE	Prophylactic or intermediate-dose LMWH/UFH	Postpartum prophylactic anticoagulation therapy or intermediate-dose LMWH/UFH
High-risk thrombophilia§ with a single previous episode of VTE or an affected first-degree relative—Not receiving long-term anticoagulation therapy	Prophylactic, intermediate-dose, or adjusted-dose LMWH/UFH	Postpartum prophylactic anticoagulation therapy, or intermediate or adjusted-dose LMWH/UFH for 6 weeks (therapy level should be equal to the selected antepartum treatment)
Two or more episodes of VTE—Not receiving long-term anticoagulation therapy (regardless of thrombophilia)	Intermediate-dose or adjusted-dose LMWH/UFH	Postpartum anticoagulation therapy with intermediate-dose or adjusted-dose LMWH/UFH for 6 weeks (therapy level should be equal to the selected antepartum treatment)
Two or more episodes of VTE—Receiving long-term anticoagulation therapy (regardless of thrombophilia)	Adjusted-dose LMWH or UFH	Resumption of long-term anticoagulation therapy. Oral anticoagulants may be considered postpartum based upon planned duration of therapy, lactation, and patient preference.

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

*VTE risk assessment should be performed prepregnancy or early in pregnancy and repeated if complications develop, particularly those necessitating hospitalization or prolonged immobility.

†First-degree relative with a history of a thrombotic episode, or other major thrombotic risk factors (eg, obesity, prolonged immobility, cesarean delivery).

‡Low-risk thrombophilia: Factor V Leiden heterozygote; prothrombin G20210A mutation heterozygote; protein C or protein S deficiency, antiphospholipid antibody.

§High-risk thrombophilias include Factor V Leiden homozygosity, prothrombin gene G20210A mutation homozygosity, heterozygosity for factor V Leiden and prothrombin G20210A mutation, or antithrombin deficiency.

VOL. 132, NO. 1, JULY 2018 Practice Bulletin Thromboembolism in Pregnancy ACOG

Thromboembolism in Pregnancy

Response

* All C-sections

* Patients with prolonged time in bed (e.g., prolonged induction of labor/ante-partum patients.)

* * *Anesthesia is an important team member*

RESPONSE

Every Unit

- Use standardized recommendations for mechanical thromboprophylaxis *
- Use standardized recommendations for dosing of prophylactic and therapeutic pharmacologic anticoagulation
- Use standardized recommendations for appropriate timing of pharmacologic prophylaxis with neuraxial anesthesia **

Thromboembolism in Pregnancy

Timing

Table 3. Timing of Neuraxial Anesthesia in Relation to Pharmacologic Prophylaxis

Antepartum or Intrapartum	
UFH prophylaxis (≤10,000 international units/d)	No contraindications to timing of heparin dose and performance of neuraxial blockade
UFH therapeutic	Wait 6 h after last dose before neuraxial blockade or check PTT
LMW heparin prophylaxis	Wait 12 h after last dose before neuraxial blockade
LMW heparin therapeutic	Wait 24 h after last dose before neuraxial blockade
Postpartum	
UFH prophylaxis (≤10,000 international units/d)	No restriction on epidural catheter removal or spinal needle placement
UFH therapeutic	Wait at least 1 h after epidural catheter removal or spinal needle placement
LMW heparin prophylaxis	Wait at least 4 h after epidural catheter removal or spinal needle placement
LMW heparin therapeutic	Avoid therapeutic placement with epidural catheter in situ; wait at least 24 h after catheter removal or spinal needle

LMW, low-molecular-weight; UFH, unfractionated heparin.

Modified from Safe Motherhood Initiative. Maternal Safety Bundle for Venous Thromboembolism. Available at: https://www.acog.org/-/media/Districts/District-II/Public/SMI/v2/VTESlideSetNov2015.pdf?la=en June 2016. Retrieved June 20, 2016. The sources cited with this box in the Safe Motherhood Initiative publication are: U.S. Food and Drug Administration. FDA Drug Safety Communication: Updated recommendations to decrease risk of spinal column bleeding and paralysis in patients on low molecular weight heparins. Available at: http://www.fda.gov/downloads/Drugs/DrugSafety/UCM373735.pdf. Retrieved June 21, 2016 *and* Horlocker TT, Wedel DJ, Rowlingson JC, Enneking FK, Kopp SL, Benzon HT, et al. Regional anesthesia in the patient receiving antithrombotic or thrombolytic therapy: American Society of Regional Anesthesia and Pain Medicine Evidence-Based Guidelines (Third Edition). Reg Anesth Pain Med 2010;35:64–101.

Source: *Obstetrics & Gynecology: October 2016 - Volume 128 - Issue 4*

Thromboembolism in Pregnancy

You don't know what you're doing if you don't measure it!

REPORTING/SYSTEMS LEARNING

Every Unit

- Review all thromboembolism events for systems issues and compliance with protocols
- Monitor process metrics and outcomes in a standardized fashion
- Assess for complications of pharmacologic thromboprophylaxis

(Wound hematoma,major bleeding episode, HIT, or skin necrosis)

Thromboembolism in Pregnancy

Complications of Therapy

- Screen for heparin induced thrombocytopenia (HIT)
- Rare complication associated with unfractionated heparin or low-molecular-weight heparin (LMWH)
- CBC 7-10 days after initiation
- Regarding HIT or severe cutaneous allergy to heparin
  - Consult hematology/pharmacology
  - Fondaparinux preferred anticoagulant
- Osteoporosis may occur with long-term heparin therapy

(≥ 7 weeks)

Thromboembolism in Pregnancy

Caveats

- Consult Anesthesia.
  - Benefit of VTE reduction may be outweighed by risk of emergent anesthesia(failed intubation/ aspiration).
- Protamine sulfate can be used to reverse unfractionated heparin or less predictably low molecular weight(LMWH).
- Complex process; therefore, consult pharmacy/hematology.
- Go to the experts

❖ Don’t tell me what you know. Tell me what you don’t know!

❖ *Clinical Pearl*

Thromboembolism in Pregnancy

Transitions

Transition to unfractionated heparin at 36 weeks.

- Shorter half-life
- More pharmacologic control
- Greater likelihood of access to neuraxial anesthesia
- Reduce risk of general anesthesia with less risk of failed intubation/aspiration/Mendelson's syndrome
- Potentially less risk of bleeding
- More readily reversible with protamine sulfate if obstetric catastrophe occurs (e.g. placental abruption)

Thromboembolism in Pregnancy

Reinstitute Therapy

- 6 hours after normal vaginal delivery (NSVD)
- 12 hours after cesarean section
- *Don't forget about anesthesia input if patient had neuraxial anesthesia!*

Thromboembolism in Pregnancy

Summary

1. VTE major cause of maternal death and morbidity.

2. Risk *significantly* mitigated by using tools for prevention and by early diagnosis and treatment.

3. Every obstetrical unit should be utilizing maternal venous thromboembolism prevention patient safety bundle.

4. Maternal mortality and morbidity crisis can not be fixed by obstetricians alone

Maternal Mortality – An American Failure

HEALTH & FITNESS

Central Valley woman dies shortly after giving birth, leaving behind loving family

Doctors had told Charlene she was bleeding internally, and that if she wanted to save her baby, she would need to have an emergency C-section.

People.com > HUMAN INTEREST

Louisiana Mom, 29, Dies One Day After Giving Birth to Baby Boy: 'Within Moments She Was Gone,' Says Partner

Tara Hansen passed away six days after giving birth to her first child, Brandon Ryan.

Trending

Ohio State Trooper Dies After Giving Birth, Doctors Warn She Won't Be The Last

By Tristan | Feb 25, 2019

Fresno mother died giving birth. She named her 'miracle' baby after heaven

Fresno father keeps his family's spirits up after wife dies during childbirth

USA TODAY

Alison Young, USA TODAY
Updated 4:54 p.m. EDT July 27, 2018

Hospitals know how to protect mothers. They just aren't doing it.

News Tribune

Hospitals seek to address troubling increase in maternal mortality across US

By John Lundy on Feb 26, 2019 at 5:00 a.m.

CBS NEWS

CBS NEWS August 5, 2018, 10:06 AM

Maternal mortality: An American crisis

USA TODAY

Maternal deaths are rising in America. Best Mother's Day gift, reverse that trend.

Opinion contributor Published 1:39 p.m. ET May 10, 2018 | Updated 9:51 a.m. ET May 13, 2018

The Seattle Times

Editorials

Maternal deaths, rising in the U.S., deserve greater scrutiny

Originally published December 27, 2018 at 2:13 pm | Updated December 31, 2018 at 8:47 am

Psychology Today

The Public Health Crisis of the Maternal Mortality Rate

What is it and how to address it

Posted Feb 25, 2019

USA TODAY

Melinda Gates: U.S. maternal death rate is 'incredibly disturbing'

Sonja Haller, USA TODAY Published 6:27 p.m. ET Jan. 17, 2019 | Updated 9:44 a.m. ET Jan. 18, 2019

The Washington Post
Democracy Dies in Darkness

Health & Science

A shocking number of U.S. women still die of childbirth. California is doing something about that.

By Michael Ollove
November 4, 2018

Harvard Health Publishing
HARVARD MEDICAL SCHOOL

Health Blog

A soaring maternal mortality rate: What does it mean for you?

npr

U.S. Has The Worst Rate Of Maternal Deaths In The Developed World

May 12, 2017 · 10:28 AM ET

Maternal Mortality & Morbidity in America

New Momentum for Change

One Hundred Fifteenth Congress
of the
United States of America

AT THE SECOND SESSION
Begun and held at the City of Washington on Wednesday, the third day of January, two thousand and eighteen

An Act

To support States in their work to save and sustain the health of mothers during pregnancy, childbirth, and in the postpartum period, to eliminate disparities in maternal health outcomes for pregnancy-related and pregnancy-associated deaths, to identify solutions to improve health care quality and health outcomes for mothers, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "Preventing Maternal Deaths Act of 2018".

SEC. 2. SAFE MOTHERHOOD.

Section 317K of the Public Health Service Act (42 U.S.C. 247b–12) is amended—

(1) in subsection (a)—

(A) in paragraph (1)—

~~Conclusion~~ Beginning

Make a change

- We are all here because we care and want to prevent maternal death and morbidity.
- There is extreme intellectual capital within the HealthTrust team of which you are a part.
- If we work together we will make America a safer place for women to have babies.
- It is incumbent on all healthcare professionals to take the responsibility to begin adopting new approaches, new tools and new thinking to reverse the rates of maternal mortality and morbidity in the U.S.
- The HealthTrust team remains here to support you.

Thank you

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HEALTHTRUST