Consensus Statement

National Partnership for Maternal Safety

Consensus Bundle on Venous Thromboembolism

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Obstetric venous thromboembolism is a leading cause of severe maternal morbidity and mortality. Maternal death from thromboembolism is amenable to prevention, and thromboprophylaxis is the most readily implementable means of systematically reducing the maternal death rate. Observational data support the benefit of risk-factor-based prophylaxis in reducing obstetric thromboembolism. This bundle, developed by a multidisciplinary working group and published by the National Partnership for Maternal Safety under the guidance of the Council on Patient Safety in Women's Health Care, supports routine thromboembolism risk assessment for obstetric patients, with appropriate use of pharmacologic and mechanical thromboprophylaxis. Safety bundles outline critical clinical practices that should be implemented in every maternity unit. The safety bundle is organized into four domains: Readiness, Recognition, Response, and Reporting and Systems Learning. Although the bundle components may be adapted to meet the resources available in individual facilities, standardization within an institution is strongly encouraged.

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See related editorial on page 681.

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Obstetric venous thromboembolism is one of the most common causes of maternal morbidity and mortality. A systematic review performed by the World Health Organization implicated embolism in 14.9% of maternal deaths in high-resource countries, including European countries, North America, Australia, New Zealand, and Japan.[1] The United Kingdom's Confidential Enquiries into Maternal Deaths (2003–2005) found that thromboembolism caused 31.1% of deaths directly related to pregnancy,[2] and the Centers for Disease Control and Prevention (2006–2010) estimated that thrombotic pulmonary embolism accounted for 9.3% of pregnancy-related deaths in the United States.[3]

Although thromboprophylaxis has been identified as the most readily implementable means of reducing maternal mortality from thromboembolism and adoption of comprehensive thromboembolism prevention strategies has reduced death from this cause,[2,4] prophylaxis recommendations from medical and surgical specialties as well as guidelines from the Royal College of Obstetricians and Gynaecologists (RCOG)[2,5,6] differ substantially from recommendations from the American College of Obstetricians and Gynecologists (the College) and the American College of Chest Physicians (ACCP).[7–9] There is inadequate evidence from randomized clinical trials on which to base management,[10] and the data supporting specific strategies are largely observational.[2,11] Given the importance of reducing

maternal thromboembolism risk, a workgroup of the National Partnership for Maternal Safety (NPMS) of the Council on Patient Safety in Women's Health Care, representing all major women's health care professional organizations, has developed a thromboembolism safety bundle that both critically reviews current guidelines and research evidence and makes recommendations for prophylaxis. The NPMS is a multi-stakeholder effort comprised of leaders from organizations across the spectrum of women's health care, including hospital organizations, professional societies, and various state, federal, and regulatory bodies focused on improving maternal health and safety in the United States.[12]

The goal of the NPMS is the adoption of the safety bundle by every birthing facility in the United States. A patient safety bundle is a set of straightforward, evidence-based recommendations for practice and care processes known to improve outcomes.[13] As with other bundles the NPMS has developed, the thromboembolism bundle is not a new guideline but rather represents a selection of existing guidelines and recommendations in a form that aids implementation and consistency of practice that is appropriate for the individual birthing facility. The consensus bundle on obstetric thromboembolism is organized into four action domains (Box 1): Readiness, Recognition, Response, and Reporting and Systems Learning. All centers providing obstetric care should implement these recommendations, and all health care providers offering obstetric care should work to implement them. Furthermore, given the wide diversity of birthing facilities, a single national protocol is not recommended; instead, each facility should adapt a single protocol to improve maternal safety based on its patient population and resources.

BACKGROUND AND EPIDEMIOLOGY

Obstetric thromboembolism prevention strategies in the United States have focused on 1) providing pharmacologic prophylaxis for women with risk factors such as prior thromboembolism events, thrombophilias, and family history of thromboembolism and 2) perioperative mechanical prophylaxis for cesarean birth.[7–9] Despite increasing use of mechanical prophylaxis during cesarean birth,[14] data from the Nationwide Inpatient Sample have demonstrated that obstetric thromboembolism increased 72% during hospitalizations for childbirth between 1998 and 2009[15,16] and remained relatively constant proportionately as a cause of maternal mortality.[3] The prevalence of risk factors for thromboembolism is rising,[15] with obesity, advanced maternal age, and major medical comorbidities becoming increasingly common.[4,17–19] A study of

Box 1. Venous Thromboembolism Prevention Maternal Safety Bundle

Readiness

Every unit

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

Recognition and Prevention

Every patient

- Apply standardized tool to all patients to assess venous thromboembolism risk at time points designated under Readiness
- Apply standardized tool to identify appropriate patients for thromboprophylaxis
- Provide patient education
- Provide all health care 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 and 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.

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population-level data compared hospitalizations for childbirth in which venous thromboembolism was diagnosed during two time periods: 1994–1997 and 2006–2009. Diabetes, heart disease, hypertension, obesity, blood transfusion, hemorrhage, preeclampsia, and postnatal infection were each significantly more likely to be present from 2006 to 2009.[15] Case reviews in the United Kingdom suggest that maternal deaths from thromboembolism occur primarily among women with risk factors such as obesity, advanced maternal age, and medical and obstetric conditions.[2]

In contrast to clinical practice in the United States, where pharmacologic prophylaxis is provided to only the highest risk women,[20] guidelines in the United Kingdom from the RCOG support broad, risk-factor based assessments for both antepartum and postpartum patients. In particular, women who have undergone cesarean birth and have any additional risk factors are likely to receive pharmacologic prophylaxis under RCOG criteria.[21,22] There is evidence that the implementation of these practice guidelines in the United Kingdom, released in 2004,[23] may have substantially decreased mortality from thromboembolism; maternal mortality rates decreased from 1.94 deaths per 100,000 births from 2003 to 2005 to 0.79 deaths per 100,000 births from 2006 to 2008.[2] The most recent U.K. report demonstrates a death rate of 1.01 from 2011 to 2013, which, although nonsignificantly higher than the rate in 2006–2008, is lower than any of the seven triennial periods from 1985 to 2005.[24]

Based on increasing maternal risk of obstetric venous thromboembolism in the United States, the failure of current strategies to decrease venous thromboembolism as a proportionate cause of maternal death, and observational evidence from the United Kingdom that risk-factor based prophylaxis may reduce risk, the NPMS working group has interpreted current epidemiology and clinical research evidence to support routine thromboembolism risk assessment and consideration of more extensive risk-factor based prophylaxis.

THE VENOUS THROMBOEMBOLISM BUNDLE

The bundle is divided into four domains: 1) the Readiness domain, which supports establishment of risk-assessment strategies throughout pregnancy; 2) the Recognition domain, which reviews clinical recommendations from major existing guidelines for patients recognized to be at increased risk for thromboembolism; 3) the Response domain, which outlines specific recommendations for prophylaxis for at-risk patients from the NPMS working group; and 4) the Reporting and Systems Learning domain, which includes recommendations for quality assurance and surveillance.

Readiness

For the "Readiness" component of the bundle, the NPMS working group recommends the establishment of risk-assessment strategies for patients throughout pregnancy. Risk assessment should occur at four timepoints in pregnancy: 1) during the first prenatal visit, 2) during all antepartum admissions, 3) immediately postpartum during a hospitalization for childbirth, and 4) on discharge home after a birth. The Joint Commission Core Measure Venous Thromboembolism Prophylaxis supports assessment of hospitalized patients for thromboembolism risk both after admission and after surgery[25]; although obstetric patients have been excluded from this requirement by the Joint Commission, the NPMS working group recommends that this measure be extended to pregnant and postpartum patients. Patients at low and high risk for thromboembolism may be differentiated successfully based on risk factors. Two widely used venous thromboembolism risk-assessment tools for nonobstetric hospitalized populations are the Caprini and Padua scoring systems.[5,6] In a retrospective study evaluating the Caprini system, risk of venous thromboembolism after surgery was 0.0% for a score of 0–1, 0.7% for a score of 2, 1.0% for a score of 3–4, and 1.9% for a score of 5 or higher.[5] In a study of medical patients, a Padua score of 4 or higher was associated with an 11.0% risk of venous thromboembolism for patients not receiving prophylaxis and a 2.2% risk of venous thromboembolism for patients receiving prophylaxis. For patients with a score of less than 4, there was a 0.3% risk of venous thromboembolism.[6] These scoring systems can be modified for obstetric patients (Appendixes 1 and 2, available online at http://links.lww.com/AOG/A834).

Recognition

The "Recognition" component of the bundle emphasizes that maternal risk should be recognized and that routine screening of obstetric patients for venous thromboembolism risk factors will identify patients at high risk for thromboembolic events. Each center should use educational initiatives and guidelines to identify patients at increased risk for thromboembolism and who therefore might benefit from pharmacologic or mechanical thromboprophylaxis or both.

This section reviews the criteria that major guidelines from the ACCP, the College, and the RCOG use to identify patients at high risk for venous thromboembolism requiring prophylaxis.[2,7–9,26] The subsequent "Response" domain includes specific thromboprophylaxis recommendations from the NPMS working group.

Recommendations From the American College of Obstetricians and Gynecologists and the American College of Chest Physicians

Current recommendations in the United States from the College and the ACCP are somewhat contradictory and, with few exceptions, nonspecific with respect to thromboprophylaxis recommendations for pregnant women.

Cesarean Birth Thromboprophylaxis

For cesarean birth, the College recommends universal perioperative use of pneumatic compression devices for all women not already receiving pharmacologic thromboprophylaxis.[7,8] Although the ACCP supports only early ambulation for "low-risk" women undergoing cesarean birth,[9] mechanical compression devices for women with Caprini scores of 1–2 undergoing abdominal–pelvic surgery are recommended.[27] According to the Caprini scoring system, all pregnant women undergoing even minor surgery would score at or above this range. Thus, there is ultimately no conflict between the recommendations of the College and the AACP. Furthermore, the ACCP guidelines preceded publication of data demonstrating a reduction in deaths from pulmonary embolism in women undergoing cesarean birth receiving mechanical thromboprophylaxis with pneumatic compression devices.[11] Available data and expert opinion support the use of pneumatic compression device thromboprophylaxis for all women undergoing cesarean birth.

With respect to women undergoing cesarean birth who have additional risk factors for venous thromboembolism, recommendations are less clear. The College recommends the combined use of pneumatic compression and unfractionated heparin or low-molecular-weight (LMW) heparin for women with additional risk factors, but the College does not specify which risk factors qualify a woman for such additional therapy beyond prior thromboembolism events or thrombophilias.[8] The ACCP recommendations suggest the combined use of mechanical and pharmacologic thromboprophylaxis for patients undergoing abdominal–pelvic surgery who have Caprini scores of 5 or higher.[9,27] In pregnancy, this primarily would involve women with personal or family histories of venous thromboembolism or a known thrombophilia but also would apply to other women with multiple common risk factors.

Antepartum Management and Thromboprophylaxis for Vaginal Birth

Thromboprophylaxis recommendations from the College for hospitalized antepartum patients and for those delivering vaginally are less clear than for cesarean birth. The College recommends either prophylactic or therapeutic anticoagulation for women "at significant risk of venous thromboembolism during pregnancy or the postpartum period, such as those with high risk acquired or inherited thrombophilias."[8] Specific recommendations are given for the latter group, with no guidance as to the proper treatment of women with other significant risk factors nor clarification of which other risk factors should be considered significant. ACCP recommendations are more specific.[9] For hospitalized nonsurgical patients, those at high risk for venous thromboembolism were defined by Padua scores of 4 or higher.[28] For such patients, daily thromboprophylaxis with LMW heparin or twice-daily thromboprophylaxis with unfractionated heparin is recommended. In pregnancy, this group primarily would include women with reduced mobility, a history of venous thromboembolism, or known thrombophilia.

Summary

The suggested protocols of these two groups may be harmonized by applying the ACCP recommendations for hospitalized, nonsurgical patients to antepartum and postpartum (vaginal birth) patients while using the more specific College guidelines for that subgroup of women with thrombophilia.[8,9] The NPMS working group notes that long-term compliance with pneumatic compression device use is highly problematic in conscious patients[29] and may contribute to mechanical thromboprophylaxis being less effective than LMW heparin or unfractionated heparin in such situations.

Recommendations From the Royal College of Obstetricians and Gynaecologists

In contrast to the College and the ACCP, recommendations from the RCOG are more aggressive and suggest pharmacologic thromboprophylaxis for a larger proportion of patients. In addition to women with prior venous thromboembolism events, recently released 2015 guidelines recommend prenatal and postpartum thromboprophylaxis with LMW heparin based on risks factors such as age older than 35 years, obesity (body mass index higher than 30 [calculated as weight (kg)/[height (m)]^2]), multiple gestation, and pregnancy resulting from assisted reproductive technology, among others (Box 2).[21,22] Pharmacologic prophylaxis is also generally suggested for antepartum hospitalizations in the absence of specific contraindications. The 2015 RCOG guidelines recommend prophylaxis for a larger proportion of women than the

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/m^2)

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/m^2)
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.

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2009 edition of the RCOG guidelines, which themselves advocated increased prophylaxis compared with College and ACCP recommendations.

Response

The "Response" component of the bundle emphasizes that, when patients are identified as high risk for thromboembolism, the response should be appropriate thromboprophylaxis based on risk factors and the clinical situation. Based on the review of available research evidence and current major guideline recommendations, the NPMS working group recommends the following prophylaxis strategies. These recommendations are based on guidelines from the College, the ACCP,

and the RCOG and take into account observational research evidence.

Outpatient Antepartum Thromboprophylaxis

The NPMS working group recommends that venous thromboembolism risk assessment be performed at the first prenatal visit and that patients receive pharmacologic prophylaxis based on criteria similar to College and ACCP guidelines. These recommendations are demonstrated in Table 1. The NPMS additionally recommends that, for patients receiving pharmacologic venous thromboembolism prophylaxis along with low-dose aspirin for the prevention of preeclampsia based on U.S. Preventive Services Task Force recommendations, aspirin be discontinued at 35–36 weeks of gestation.[30] Recommendations for screening for heparin-induced thrombocytopenia are discussed below.

High-risk thrombophilias include: 1) factor V Leiden homozygosity; 2) prothrombin gene mutation homozygosity; 3) factor V Leiden, prothrombin gene mutation compound heterozygosity; and 4) antithrombin III deficiency. Low-risk thrombophilias include: 1) factor V Leiden or prothrombin gene mutation heterozygosity and 2) protein C or S deficiency. The primary acquired thrombophilia is antiphospholipid antibody syndrome.

Inpatient Antepartum Thromboprophylaxis

The NPMS working group recommends thromboprophylaxis with daily LMW heparin or twice-daily unfractionated heparin for all antepartum patients hospitalized for at least 72 hours who are not at high risk for bleeding or imminent childbirth. Patients receiving unfractionated heparin or LMW heparin on an outpatient basis should have this treatment continued if hospitalized. For women at high risk for childbirth or bleeding, mechanical thromboprophylaxis or a prophylactic dose of unfractionated heparin (5,000 units every 12 hours) should be used. The selective use of unfractionated heparin rather than LMW heparin may facilitate intrapartum neuraxial anesthesia.

Vaginal Birth

For women with a history of venous thromboembolism or a thrombophilia, the NPMS working group recommends intrapartum use of pneumatic compression while in bed and postpartum administration of LMW heparin or unfractionated heparin. These recommendations would result in fewer women receiving pharmacologic prophylaxis than those cared for using RCOG recommendations, which support thromboprophylaxis for women with risk factors such as obesity, smoking, and advanced maternal age. For women at high risk for venous thromboembolism based on RCOG criteria or Padua scores of 4 or higher, pharmacologic prophylaxis with LMW heparin or unfractionated heparin may be considered.

Cesarean Birth

The NPMS working group recommends that all women undergoing cesarean birth who are not receiving pharmacologic prophylaxis receive perioperative

Table 1. National Partnership for Maternal Safety Recommendations for Antepartum Outpatient Prophylaxis

Clinical History	Anticoagulation
Multiple prior venous thromboembolism episodes Prior venous thromboembolism with high-risk thrombophilia Prior venous thromboembolism with acquired thrombophilia	Treatment-dose LMW heparin or UFH
Idiopathic prior venous thromboembolism Prior venous thromboembolism with pregnancy or oral contraceptive Prior venous thromboembolism with low-risk thrombophilia Family history of venous thromboembolism with high-risk thrombophilia High-risk thrombophilia (including acquired)	Prophylactic-dose LMW heparin or UFH
Low-risk thrombophilia Prior venous thromboembolism provoked Low-risk thrombophilia and family history of venous thromboembolism	No treatment

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 table in the Safe Motherhood Initiative publication are: Thromboembolism in Pregnancy. Practice Bulletin No. 123. American College of Obstetricians and Gynecologists. Obstet Gynecol 2011;118:718–29 *and* Bates SM, Greer IA, Middeldorp S, Veenstra DL, Prabulos AM, Vandvik PO, et al. VTE, thrombophilia, antithrombotic therapy, and pregnancy: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. Chest 2012;141:e691S–736S.

mechanical thromboprophylaxis with pneumatic compression devices, which should be continued until the patient is fully ambulatory. The NPMS recommends use of pharmacologic thromboprophylaxis for women with risk factors. A careful review reveals that many women undergoing cesarean birth will have multiple risk factors and therefore might be considered at particularly high risk based on RCOG criteria or the modified Caprini scoring systems (Appendix 1, http://links.lww.com/AOG/A834). Given the challenges in consistently identifying women with risk factors and issues related to poor compliance with mechanical devices,[29] hospitals may choose a strategy in which all women undergoing cesarean birth receive postoperative thromboprophylaxis with unfractionated or low-molecular-weight heparin unless there is a specific contraindication. This approach is consistent with the RCOG recommendations.[21] Although there are no data on the optimal timing of initiating heparin postoperatively, the NPMS working group supports the routine administration of prophylactic unfractionated heparin when postcesarean patients otherwise meet criteria for postanesthesia care unit discharge.

Extended Postpartum Thromboprophylaxis

Table 2 demonstrates NPMS working group recommendations for risk assessment and thromboprophylaxis recommendations for extended pharmacologic postpartum anticoagulation on hospital discharge from a hospitalization for childbirth. These recommendations are based primarily on College and ACCP criteria.[7–9]

Timing of Anesthesia

At the time of publication, preliminary recommendations from guidelines from the American Society for Regional Anesthesia and Pain Medicine (ASRA) on venous thromboembolism prophylaxis and neuraxial anesthesia suggest that neuraxial procedures be delayed at least 4 (and preferably 6) hours after a 5,000-unit dose of subcutaneous unfractionated heparin (information available on the ASRA app under "heparin-prophylactic"/"neuraxial block"/"place neuraxial block"[31]). Longer intervals are recommended for LMW heparin and other unfractionated heparin regimens. Additionally, the preliminary ASRA recommendations support restricting use of concurrent nonsteroidal anti-inflammatory drugs after neuraxial anesthesia with certain regimens of pharmacologic anticoagulation.

How or if these recommendations from ASRA may change practice, or access to neuraxial analgesia, is unclear at this time. In the setting of increased focus on obstetric thromboembolism, the Society for Obstetric Anesthesia and Perinatology is concurrently preparing an expert statement that includes guidance on pharmacologic prophylaxis recommendations in

Table 2. National Partnership for Maternal Safety Recommendations for Postpartum Prophylaxis After Hospitalization for Childbirth

Clinical History	Anticoagulation
Multiple prior venous thromboembolism episodes Prior venous thromboembolism with high-risk thrombophilia Prior venous thromboembolism with acquired thrombophilia	6 wk treatment-dose LMW heparin or UFH
Idiopathic prior venous thromboembolism Prior venous thromboembolism with pregnancy or oral contraceptive Prior venous thromboembolism with low-risk thrombophilia Family history of venous thromboembolism with high-risk thrombophilia High-risk thrombophilia (including acquired) Prior venous thromboembolism provoked* Low-risk thrombophilia and family history of venous thromboembolism*	6 wk prophylactic-dose LMW heparin or UFH
Low-risk thrombophilia	No treatment

LMW, low-molecular-weight; UFH, unfractionated heparin.
* Changes from initial assessment.
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 table in the Safe Motherhood Initiative publication are: Thromboembolism in Pregnancy. Practice Bulletin No. 123. American College of Obstetricians and Gynecologists. Obstet Gynecol 2011;118:718–29 *and* Bates SM, Greer IA, Middeldorp S, Veenstra DL, Prabulos AM, Vandvik PO, et al. VTE, thrombophilia, antithrombotic therapy, and pregnancy: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. Chest 2012;141:e691S–736S.

relation to neuraxial anesthesia; this statement will be particularly important in coordinating management between obstetricians and obstetric anesthesiologists. As recommendations on neuraxial anesthesia and pharmacologic prophylaxis evolve, communication between obstetricians and anesthesiologists will be critical to providing optimal care at both the patient-by-patient and hospital level.

Based on current evidence, the NPMS working group makes the following additional recommendations in regard to neuraxial anesthesia and pharmacologic prophylaxis:

1. Table 3 demonstrates recommendations for timing of neuraxial anesthesia in relation to pharmacologic thromboprophylaxis. These recommendations will apply to most women requiring venous thromboembolism prophylaxis during pregnancy.
2. For hospitalized antepartum patients at increased risk of emergently requiring anesthesia for childbirth (including patients admitted with preterm premature rupture of membranes, preterm labor, and other conditions), the benefits of venous thromboembolism risk reduction from pharmacologic compared with mechanical prophylaxis may be outweighed by risks from restrictions on neuraxial anesthesia. In such cases, we recommend consultation with the anesthesiologist and ongoing multidisciplinary communication about evolving care plans to anticipate the need for neuraxial anesthesia and for any adjustments of pharmacologic prophylaxis, or coagulation testing, or both.
3. The appropriate time interval between a dose of 7,500 or 10,000 units of subcutaneous unfractionated heparin administered twice daily and placement of neuraxial anesthesia is unclear. For the small proportion of patients receiving prophylactic unfractionated heparin on an outpatient basis, the decision to use 5,000 units twice daily compared with a higher dose should be based on consideration of the risks and benefits of a higher dose, taking into account potential restrictions on neuraxial anesthesia if urgent or emergent delivery is required.
4. The NPMS working group supports the concurrent use of nonsteroidal anti-inflammatory drugs and low-dose prophylactic unfractionated heparin or LMW heparin after neuraxial anesthesia and cesarean birth given extensive clinical practice supporting the safety of this treatment and patient benefit in terms of decreased use of opioids.

Screening for Heparin-Induced Thrombocytopenia

Heparin-induced thrombocytopenia is an extremely rare complication for obstetric patients receiving unfractionated heparin or LMW heparin for prophylaxis.

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.

It is unclear whether evidence supports screening for obstetric patients receiving prophylactic-dose unfractionated heparin or LMW heparin anticoagulation. For patients expected to be on either unfractionated heparin or LMW heparin for more than 7 days, a reasonable clinical strategy would include checking a complete blood count 7 to 10 days after initiation of therapy. Guidelines from ASRA recommend that patients receiving heparin for more than 4 days have platelet counts checked before neuraxial block and catheter removal.[32]

Appropriate Use of Mechanical Prophylaxis

A recent report reviewing sequential compression device use found that compliance was low for patients who underwent cesarean birth (52.5%). Reasons for noncompliance included patient factors, nursing factors, and systems issues.[29] Other reports support these findings.[33] It is unclear to what degree nursing and patient interventions may improve compliance.[29] For patients receiving postcesarean mechanical prophylaxis, optimal duration of use and criteria for discontinuation are unclear. Recommendations from the College state that pneumatic compression devices, "should be used continuously until ambulation and discontinued only at the time of hospital discharge."[34] The precise definition of "fully ambulatory" for postcesarean patients is unclear given that ambulation often is initiated on postoperative day 1 and increases daily thereafter.

Based on available evidence, the NPMS working group supports the following recommendations with regard to mechanical prophylaxis:

For patients for whom mechanical prophylaxis is indicated, device use is recommended while patients are in bed until hospital discharge.

Because device compliance may be low, individual centers should consider the relative benefits of pharmacologic prophylaxis for at-risk patients given that administration is less likely to be affected by patient, nursing, or systems factors.

Reporting and Systems Learning

The NPMS working group recommends that individual centers review samples of their obstetric population to determine the prevalence of comorbid risk factors for venous thromboembolism to aid in tailoring prophylaxis policies. Once a policy has been enacted, we recommend routinely auditing medical records to ensure that risk assessment is being performed and at-risk patients are receiving appropriate prophylaxis. Although protocols and electronic medical record tools may aid in appropriate prophylaxis, medication administration in scenarios in which it is contraindicated is also possible. The proportion of patients receiving prophylaxis for whom prophylaxis is indicated should be audited and reported. Similarly, each obstetric thromboembolism event should be reviewed to determine whether optimal care and prophylaxis was provided. Finally, adverse events and complications from pharmacologic prophylaxis should be reviewed and reported.

DISCUSSION

The general approach to thromboprophylaxis outlined above is fundamentally consistent with most current ACCP recommendations for nonpregnant patients. As such, it has the advantage of bringing obstetrics into line with the recommendations of other specialties as well as into compliance with the Joint Commission and their Surgical Care Improvement Project core measures for thromboprophylaxis. Such uniformity is an important component of basic patient safety principles recommended by the Institute of Medicine. In addition, such an approach brings to bear established and well-functioning quality assurance systems already in place in most facilities whose job it is to ensure compliance with these core measures. These recommendations would result in fewer women receiving venous thromboembolism prophylaxis than would universal application of the RCOG recommendations, but they may be better received and implemented by a specialty in which pharmacologic thromboprophylaxis of any type is rarely used at this time.[14,20] On the other hand, the track record of the RCOG recommendations in reducing obstetric venous thromboembolism is impressive and cannot be discounted; death from obstetric venous thromboembolism in the United Kingdom in the setting of a comprehensive thromboprophylaxis program has decreased significantly. Ultimately, there exists no evidence to suggest superiority of one approach over the other (RCOG compared with those outlined in this article) for preventing morbidity and mortality from both venous thromboembolism and medication used for its prophylaxis. Either approach should be considered to be in compliance with standards of care in the United States. We recommend that each facility carefully consider these protocols and formally adopt and implement one of them in

a systematic way to reduce the incidence of venous thromboembolism in pregnancy.

The goal of this safety bundle is to reduce the frequency of obstetric thromboembolism and improve maternal outcomes. The bundle is inherently multidisciplinary and is designed to assist in establishing a culture of safety. Although we recognize the need to individualize the specific details of these protocols to fit available resources, every unit should strive to implement prophylaxis strategies incorporating leadership from anesthesiology, obstetrics, midwifery, and nursing. The Council on Patient Safety in Women's Health Care includes this safety bundle and resources to support its implementation and direct health care providers to a growing number of state and national quality collaboratives that stand ready to assist (www.safehealthcareforeverywoman.org).

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