# The Society for Obstetric Anesthesia and Perinatology Interdisciplinary Consensus Statement on Neuraxial Procedures in Obstetric Patients with Thrombocytopenia

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ABSTRACT:

As thrombocytopenia in pregnancy occurs in up to 12% of obstetric patients, it is not infrequent that the obstetric anesthesiologist must consider whether to proceed with a neuraxial anesthesia in an affected patient. Given the morbidity associated with the alternatives, such as general anesthesia for cesarean delivery, an estimate of the relative risk of spinal epidural hematoma is important to consider. Whereas multiple other professional societies (obstetric, interventional pain, and hematologic) have published guidelines addressing platelet thresholds for safe neuraxial procedures, the U.S. anesthesia professional societies have been silent on this topic. Despite the paucity of high-quality data, there are currently meta-analyses that provide better

estimations of sample risks. The goal of this interdisciplinary taskforce was to unite the relevant professional societies, synthesize the best available data, and provide a practical decision algorithm to help inform risk/benefit discussions with patients and aid in shared decision making.

Abbreviated Title: Neuraxial Procedures in Thrombocytopenic Parturients

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*Why was this consensus statement developed?*

This consensus statement was commissioned by the Society for Obstetric Anesthesia and Perinatology (SOAP) to address the risks and benefits of performing neuraxial procedures in obstetric patients with thrombocytopenia. Representatives were chosen to provide interdisciplinary input by the following subspecialty professional organizations: American Society of Regional Anesthesia and Pain Medicine (ASRA), American College of Obstetricians and Gynecologists (ACOG), Society for Maternal Fetal Medicine (SMFM), and the American Society for Hematology (ASH).

*What other statements or guidelines are available on this topic?*

There are multiple national subspecialty professional organizations (hematology, obstetric, transfusion medicine) that address the performance of neuraxial procedures in thrombocytopenic patients, but the U.S. anesthesia professional organizations have remained silent on this topic.

*How does this statement differ from existing guidelines?*

This consensus statement focuses on obstetric patients with thrombocytopenia (defined as platelet count < 100,000 x $10^6$/L), whereas existing guidelines cover a range of other related topics and patient populations, primarily related to lumbar punctures.

Glossary of Terms: American College of Obstetricians and Gynecologists (ACOG), American Society of Regional Anesthesia and Pain Medicine (ASRA), American Society for Hematology (ASH), Society for Maternal Fetal Medicine (SMFM), Society for Obstetric Anesthesia and

Perinatology (SOAP), Research Electronic Data Capture (REDCap), class of recommendation (COR), level of evidence (LOE), American College of Cardiology/American Heart Association (ACC/AHA), acute fatty liver of pregnancy (AFLP), immune thrombocytopenia (ITP), thrombotic thrombocytopenic purpura (TTP), lupus anticoagulant (LA), anticardiolipin antibody (aCL), antinuclear antibody (ANA), prothrombin time (PT), activated partial thromboplastin time (aPTT), confidence interval (CI), complete blood count (CBC), ethylenediamine tetra-acetic acid (EDTA), thromboelastography (TEG), rotational thromboelastometry (ROTEM), platelet function analyzer (PFA-100), intravenous immunoglobulin (IVIG), cyclooxygenase (COX), Collaborative Low-dose Aspirin Study in Pregnancy (CLASP), Society of Interventional Radiology (SIR), lactate dehydrogenase (LDH), aspartate aminotransferase (AST), alanine aminotransferase (ALT), disseminated intravascular coagulopathy (DIC), magnetic resonance imaging (MRI), Association of Anaesthetists of Great Britain and Ireland (AAGBI), Sociedade Brasileira de Anestesiologia (SBA), Belgium Association for Regional Anaesthesia (BARA), European Society of Anesthesiology (ESA), Scandinavian Society of Anesthesiology (SCA), AABB (formerly, the American Association of Blood Banks), The Dutch Institute of Healthcare Improvement (CBO), Italian Society of Transfusion Medicine and Immunohaematology (SIMTI), French Safety Agency for Health Products (AFSSaPS), peripheral blood smear (PBS)

## PART I.

### Introduction

Thrombocytopenia in pregnancy, defined as <150,000 x $10^6$/L, occurs in 7-12% of women.[1] Obstetric patients with thrombocytopenia are often denied neuraxial procedures due to the perceived increased risk for spinal epidural hematoma. Opting for general anesthesia rather than neuraxial anesthesia can result in severe maternal and fetal morbidity. Maternal and fetal risk related to general anesthesia are displayed in Box 1. Despite the paucity and low quality of evidence to guide anesthetic practice, anesthesiologists must make clinical decisions (often with time constraints) about whether to proceed with neuraxial anesthesia in obstetric patients with thrombocytopenia. This consensus statement was developed to provide the best available evidence and a clinical decision aide to inform risk-benefit discussions with patients and enable anesthesiologists to engage in effective shared decision-making.

### Methods

The taskforce formulated this consensus statement based on a general and systematic review of the literature, and an extensive modified Delphi process that occurred from January 2018 to December 2020. A total of 17 representatives were designated by the Board of Directors of SOAP and each of the participating subspecialty professional organizations (ASRA, ACOG, SMFM, and ASH). These designees included experts in the hematologic and obstetric implications of thrombocytopenia in pregnancy, neuraxial anesthesia, and statistical methods. Prospective members were initially contacted by their professional organization to assess their interest (all elected to participate), and then received a standard, formal letter of invitation. The

taskforce members (4 hematologists, 2 obstetricians, 9 anesthesiologists, 1 statistician, 1 librarian scientist) came from 15 academic institutions. An obstetric patient with thrombocytopenia was invited to review the decision aid and provided feedback as well.

The modified Delphi consensus process included both formal and informal methods. An extensive risk assessment was done using a Research Electronic Data Capture (REDCap) survey of taskforce members and 17 additional SOAP-affiliated anesthesiologists chosen to represent diverse geographic and practice settings. A second focused survey was then administered to the 4 hematology experts. Surveys available in the literature regarding willingness to perform neuraxial procedures in the obstetric patient with thrombocytopenia were reviewed, incorporated into deliberations, and are presented in Table 2. Subsequent communications occurred via in-person meetings, telephone meetings, and e-mail communications. Differences of opinion were discussed, and consensus was attained.

*Literature and Systematic Review*

The taskforce reviewed relevant literature to create this consensus statement. The search strategy is available in a previously published systematic review and meta-analysis that identified all published cases of neuraxial procedures (lumbar puncture; spinal, epidural, combined spinal epidural procedures; epidural catheter removal) performed in diverse populations of thrombocytopenic patients and subsequent development of spinal epidural hematoma.[2] The meta-analysis found the estimated event rate for all neuraxial procedures in patients with a platelet count of 75,000 to 100,000 x $10^6$/L within the sample to be 0.097% (95% CI 0.002, 0.2%), consistent with previous upper bound estimates in prior studies of thrombocytopenic

obstetric patients.[3-6] Probability mapping across all platelet counts displayed an inflection point near 75,000 x $10^6$/L indicating a low probability of events above this threshold in the sample.[2]

*Grading of Consensus Recommendations*

Recommendations are categorized by Class of Recommendation (COR) and Level of Evidence (LOE) based on the American College of Cardiology/American Heart Association (ACC/AHA) classification system.[7] COR denotes the risk-benefit ratio and strength of recommendation [Class I (strong), Class IIa (moderate), Class IIb (weak), and III (no benefit or harm)]. LOE describes the quality of evidence [Level A (high quality evidence from greater than 1 RCT), Level B-R (Randomized), Level B-NR (Nonrandomized), Level C-LD (Limited Data), and Level C-EO (expert opinion)]. Two authors (M.B. and K.A.) reviewed the evidence and graded the recommendations. If disagreements could not be resolved by discussion, a third author was consulted for resolution (L.L.).

## Background

*Thrombocytopenia in pregnancy and postpartum*

The more common diagnoses of thrombocytopenia in pregnancy include: (1) gestational thrombocytopenia, (2) immune thrombocytopenia (ITP), and (3) thrombocytopenia associated with hypertensive disorders of pregnancy [e.g., preeclampsia; hemolysis, elevated liver enzymes, low platelet count (HELLP syndrome)]. Rarer conditions either associated with pregnancy [(e.g., acute fatty liver of pregnancy (AFLP)] or not associated with pregnancy (e.g., thrombotic thrombocytopenic purpura (TTP) or inherited thrombocytopenia), and sepsis-induced thrombocytopenia were outside the scope of these recommendations. The incidence and associated findings of each condition are presented in Table 3. The detailed evaluation and

workup of thrombocytopenia in pregnancy is outside the scope of these recommendations, but has been reported elsewhere.[1,8]

The antepartum work-up of thrombocytopenia in pregnancy should include a thorough evaluation of bleeding history, comorbidities, and medications associated with thrombocytopenia. Platelet count prior to pregnancy and during pregnancy should be evaluated. General bleeding history questions may be falsely positive for at least one symptom in 25-46% of patients without a bleeding diathesis.[9] Studies comparing general screening questions on bleeding symptoms administered to controls and patients with Von Willebrand's disease are variable in sensitivity for predicting disease.[9,10] However, targeted questions addressing family history of bleeding disorders and bleeding after surgical procedures (tonsillectomy, tooth extraction) may be useful to detect bleeding disorders.[10-12] Specific bleeding risk assessment models have been reviewed and distilled into a set of questions to evaluate bleeding history (Box 2).[13-15]

*Thrombocytopenia-related Complications of Neuraxial Anesthesia: Spinal Epidural Hematoma*

Spinal epidural hematoma is the thrombocytopenia-related complication of neuraxial anesthesia with the highest morbidity. The incidence in obstetric patients is estimated to be between 1:200,000-1:250,000.[16,17] However, the incidence of spinal epidural hematoma specifically in obstetric patients with thrombocytopenia (<100,000 x $10^6$/L) is unknown. In a 2020 systematic review and meta-analysis reviewing 7476 procedures in a cohort of heterogeneous thrombocytopenic patients (between 1947 and 2018), most spinal epidural hematomas occurred in patients with lumbar punctures and platelet counts less than 50,000 x $10^6$/L.[2] Of a total 33 spinal epidural hematomas, within the platelet count ranges of 1–

25,000×$10^6$/L, 26–50,000×$10^6$/L, 51–75,000×$10^6$/L, and 76–99,000×$10^6$/L there were 14,6,9, and 4 spinal epidural hematomas, respectively. There were only 5 reported obstetric patients with spinal epidural hematoma with platelet counts between 44,000-91,000 x $10^6$/L (2 after epidural and 3 after spinal procedures).[2] One of the patients had an underlying spinal arteriovenous malformation and the other was coagulopathic at the time of inadvertent epidural catheter removal. These were thought to be contributory comorbidities. Of the 3 remaining patients, 2 had HELLP syndrome and 1 had eclampsia.

In that same study, the clinical presentations of spinal epidural hematoma were diverse: the patients had a wide range of presenting symptoms including lower extremity motor deficits 13 (59%), back pain 9 (41%), lower extremity pain 2 (9%), lower extremity paresthesia 5 (23%), saddle paresthesia 2 (9%), and urinary or bowel dysfunction 6 (27%). Multiple patients presented with more than one deficit. Notably, 18 (95%) were symptomatic within 48 hours of the procedure. Experts report that prompt imaging and neurosurgical consultation for lumbar decompression is crucial to improve outcomes. It is recommended that patients undergo decompressive laminectomy within 8 hours of onset of neurologic dysfunction, as there is evidence that a higher percentage had full or partial neurologic recovery when laminectomy was performed during that time frame.[18]

An additional study analyzing 573 obstetric patients with thrombocytopenia combined with 951 cases from the literature reported 1,524 patients received neuraxial procedures without developing a spinal epidural hematoma. Although no spinal epidural hematomas were reported, the authors were able to estimate the upper bound risk with 95% confidence intervals (CI) for spinal epidural hematoma stratified by platelet count. For platelet counts between 70-100,000 x $10^6$/L, 50-69,000 x $10^6$/L, and less than 50,000 x $10^6$/L, the risk estimates with 95% CI were

0.2%, 3%, and 11%, respectively.[19] A more recent study reported an additional 471 patients and further reduced the upper bound risk estimates to 0.19%, 2.6%, and 9%.[6]

*Laboratory Assessment of Bleeding Risk*

The complete blood count (CBC), which provides the absolute platelet count within approximately ~± 3% coefficient of variation, can identify which obstetric patients have thrombocytopenia.[20] Rarely, a patient may have a spuriously low platelet automated count due to clumping induced by ethylenediamine tetra-acetic acid (EDTA). If there is a spuriously low platelet count due to clumping, once the sample has been collected in a tube with an alternative anticoagulant (e.g., citrate) or counted manually on peripheral blood smear, the platelet count will be normal.

Ideally, additional laboratory testing would assess the interplay between platelet number, platelet function, and other essential coagulation elements to elucidate which obstetric patients are at increased risk for major neuraxial bleeding. The activated partial thromboplastin time (aPTT) and prothrombin time (PT) assays use a phospholipid emulsion instead of platelets to test for inherited or acquired factor deficiencies. Unless an inherited or acquired coagulation defect is known or suspected, the PT and aPTT have no utility in predicting bleeding risk in a pregnant woman with thrombocytopenia. Available coagulation tests are summarized in **Table 4.**

Thromboelastography (TEG) and rotational thromboelastometry (ROTEM) are dynamic point of care tests that evaluate the viscoelastic properties of blood clots in whole blood subjected to rotational forces. While there have been studies reporting the use of ROTEM or TEG (with normal parameters) prior to neuraxial procedures in thrombocytopenic obstetric

patients without spinal epidural hematoma formation,[21,22] other studies in thrombocytopenic patients have reported no correlation between TEG and ROTEM parameters and clinical bleeding except at very low platelet counts (< 20,000 x $10^6$/L).[23,24]

The platelet function analyzer (PFA-100) tests platelet function by simulating the in-vivo hemostatic mechanism of platelet plug formation. Time to formation of the platelet plug is the closure time (CT). An abnormal CT may be found in patients with thrombocytopenia (platelet <100,000 x $10^6$/L), anemia (hemoglobin <10g/dL), or a significant qualitative platelet defect. However, this test lacks specificity and predictive value for a specific disorder and does not correlate with degree of bleeding risk.[25] The platelet aggregation test measures agglutination and aggregation of platelets in response to different agonists, but studies evaluating its utility in obstetric patients are lacking.

There are several studies that suggest abnormalities in hemostasis parameters such as PT, aPTT, TEG-MA, and PFA-CT in some patients with preeclampsia.[21,22,26-33] Some have demonstrated that compared to patients without preeclampsia, preeclamptic patients with normal platelet count appear to be hypercoagulable.[34,35] Two of these studies highlight a platelet count of 70-75,000 x $10^6$/L as the cut-off below which TEG suggests hypocoagulability.[29,31] However, there is a notable degree of inconsistency correlating hemostatic laboratory parameters in these studies and lack of data showing correlation between these laboratory tests and the risk of spinal epidural hematoma. Therefore, the expert panel felt that there was insufficient evidence to recommend the routine use of one or more of these laboratory tests in pregnant or postpartum women with thrombocytopenia for determination of the safety for neuraxial anesthesia.

*Platelet transfusion prior to neuraxial procedures*

Some professional organizations recommend administering prophylactic platelet transfusions prior to lumbar puncture for platelet counts ranging from less than 20,000 to less than 50,000 x $10^6$/L to decrease the risk of spinal epidural hematoma (Table 1).[36-40] However, careful consideration of the associated risks and benefits is required to evaluate whether this approach is advisable. A recent Cochrane review found "no evidence from randomized controlled trials or non-randomized studies on which to base an assessment of the correct platelet transfusion threshold prior to insertion of a lumbar puncture needle or epidural catheter." [41] Further, they suggested that in order to detect an increase in the number of patients with major procedure-related bleeding from 1/1000 to 2/1000, the sample size needed would be more than 47,000 patients.

Platelet transfusion also has associated risks, including transfusion reaction, transfusion-related acute lung injury, and transfusion-associated circulatory overload. In the UK, 34% of transfusion related adverse events were due to platelet transfusion.[42] Although a transfused whole blood unit of platelets is expected to increase the platelet count between 5-10,000 x $10^6$/L, and a pheresis derived bag of platelets is expected to increase the platelet count between 30-50,000 x $10^6$/L, increases in platelet numbers are variable in response to transfusions. Furthermore, platelet transfusions may be less effective in patients with preeclampsia or other disorders, likely due to platelet consumption.[43] There are a few reports of improvement in platelet count in HELLP syndrome after plasma exchange, but generally not with platelet transfusion alone.[44-46] ACOG recommends platelet transfusion in preeclampsia for active bleeding or to improve the platelet count to 50,000 x $10^6$/L prior to cesarean delivery.[1]

For the treatment of ITP in pregnancy, the American Society of Hematology guidelines note that platelet transfusion alone is not usually effective, but can be considered with concurrent

intravenous immunoglobulin (IVIG)[47] or corticosteroid therapy.[48] However, specific platelet thresholds at which pregnant patients with ITP should be treated were not identified. According to ACOG, in pregnant women with thrombocytopenia, treatment with IVIG or corticosteroids is recommended if the patient has symptomatic bleeding, for a platelet count less than 30,000 x $10^6$/L, and/or to increase to platelet counts considered safe for procedures (e.g., neuraxial procedures and cesarean delivery).[1] Platelet transfusions are recommended to temporize only in cases of life-threatening hemorrhage or to prepare for urgent surgery as the response to platelet transfusion is short-lived.[1]

*Thrombocytopenia, Aspirin Therapy and Bleeding Risk*

The taskforce members concluded that there was insufficient evidence to make a recommendation about performing neuraxial procedures in pregnant and postpartum women with thrombocytopenia taking aspirin. This is a clinically relevant question as ACOG recommends a low dose (81 mg/day) aspirin be administered to pregnant women at high risk for preeclampsia and be considered for women with one or more of several risk factors for preeclampsia.[49] Aspirin irreversibly inhibits cyclooxygenase (COX) required for thromboxane synthesis, subsequently reducing platelet aggregation for the life of the platelet. The plasma half-life of aspirin is 20 minutes.[50] Although the lifetime of the platelet can be up to 10 days, platelet activity is restored by approximately 10% each day due to platelet turnover. It may take up to 10 days for the entire platelet population to be renewed; however, normal hemostasis has been shown with as little as 20% normal platelet COX activity.[51]

Existing professional organization guidelines were reviewed by the panel and none provided guidance for the scenario of thrombocytopenia with concomitant aspirin use. There are limited data that can be gleaned from studies of pregnant women on aspirin although these patients did not have concomitant thrombocytopenia. In the Collaborative Low-dose Aspirin Study in Pregnancy (CLASP), 1422 women had epidural procedures while taking 60 mg aspirin daily. None of the patients developed an epidural hematoma.[52] In a separate study, the PFA-100 was used to analyze platelet function in pregnant women taking aspirin (81 mg). After four weeks, 25 of 87 women (28.7%) did not have changes in the PFA-100 testing suggesting that not all women have changes in platelet function while taking low-dose aspirin.[36] Similarly, a TEG study of platelet function did not show any measurable changes in 12 pregnant and 8 non-pregnant volunteers six hours after ingesting high-dose aspirin 600 mg.[53]

In summary, considering the paucity of evidence to guide practice in obstetric patients with thrombocytopenia and concomitant aspirin use, clinicians and patients should engage in shared decision-making about the perceived competing risks/benefits of proceeding with or withholding neuraxial anesthesia in cases of severe thrombocytopenia and concurrent aspirin use.

*Recommendations from other Professional Organizations Regarding Platelet Thresholds for Neuraxial Procedures*

Obstetric, hematologic, oncologic, radiologic, transfusion medicine, and neurological societies have made recommendations regarding platelet thresholds for neuraxial procedures. Lumbar punctures had the lowest recommended acceptable range (20-50,000 x $10^6$/L) in order to perform diagnostic lumbar puncture in patients with leukemia or suspected meningitis. [54-57,58] Societal recommendations for anesthetic neuraxial procedures most commonly use a limit of 80,000 x $10^6$/L.[59] However, the Scandinavian Society of Anaesthesiology recommends lower

thresholds for anesthetic neuraxial procedures that specifically are thought to decrease morbidity and mortality, and for single shot spinal compared to epidural procedures. If the benefit is analgesia, then the threshold for an epidural procedure is 100,000 x $10^6$/L. [60] The Association of Anaesthetists of Great Britain and Ireland (AAGBI) is the only society that specifically addresses obstetric patients and provides *risk levels of spinal epidural hematoma* at various platelet count thresholds for specific disease states such as preeclampsia, ITP, intrauterine fetal demise, and placental abruption. (Table 1).[61]

**PART II.**

## I. Recommendations for Physician Anesthesiologists and other Practitioners

This consensus statement is not intended to set out a legal standard of care and does not replace medical care or the judgement of the responsible medical professional considering all the circumstances presented by an individual patient. This statement is not intended to ensure a successful patient outcome in every situation and is not a guarantee of any specific outcome. This consensus statement is subject to periodic revision as additional data becomes available. In all cases it is assumed that the obstetric patients with thrombocytopenia do not have additional contraindications to neuraxial anesthesia.

The decision of whether to proceed with a neuraxial procedure in an obstetric patient with thrombocytopenia occurs within a clinical context. Potentially relevant factors include, but are not limited to the following: comorbidities, obstetric risk factors, airway exam, available airway equipment, risk of general anesthesia, and patient preference. Each of these factors was considered during the modified Delphi process. Additionally, in some centers, expert hematologic consultation is available 24 hours a day, 7 days a week; at others, it is rarely or

never available on site. In response, the recommendations were crafted to account for patient and practice setting variation. Finally, there were lengthy discussions of whether the risk of spinal epidural hematoma was lower in the setting of a spinal versus an epidural procedure as this distinction appears in some publications and international professional organizations' recommendations. This hypothesis is intuitively plausible, given the smaller gauge of spinal versus epidural needles (25-29 versus 17-18), the "pencil point" versus "cutting" needle tip, and the lack of in situ catheter. However, we were unable to find even low-quality evidence to support this notion. In the 2020 systematic review of spinal epidural hematomas, the largest number of hematomas occurred in severely thrombocytopenic oncology patients (< 50,000 x $10^6$/L) that received lumbar punctures, in part because relatively few obstetric and other patients received spinal or epidural anesthetics with that degree of thrombocytopenia.

For guiding the assessment of whether to proceed with neuraxial anesthesia in the pregnant patient, we have divided the thrombocytopenic obstetric population into two categories: A) the patient with a *known thrombocytopenia etiology* and B) the patient *without a known thrombocytopenia etiology*. For the purposes of this consensus statement, patients with a known diagnosis of ITP have had a workup by a hematologist prior to pregnancy. Patients with gestational thrombocytopenia will have had a normal platelet count prior to pregnancy or early pregnancy and had a decline during pregnancy to ≥ 70,000 x $10^6$/L. Patient with hypertensive disorders of pregnancy have met diagnostic criteria. Patients with an unknown thrombocytopenia etiology may include a patient that presents during pregnancy with new thrombocytopenia compared to previous platelet counts, without a clear etiology, or one for whom no previous platelet counts are available for comparison. Neuraxial procedures are defined as the following:

(spinal, combined spinal epidural, dural puncture epidural, and epidural procedures) and epidural catheter removal.

**A. The obstetric patient with a *known etiology of thrombocytopenia* by prior workup or confirmed diagnosis of hypertensive disorders of pregnancy (Figure 1)**

1. Document that the patient has been screened for a possible underlying disorder of hemostasis (Box 2) and has no visible signs of disseminated intravascular coagulopathy (DIC) such as bleeding from IV sites, catheters, wounds, or new mucocutaneous bleeding. **In the absence of those findings, the following recommendations apply**[*]:
    - **a.** For confirmed diagnosis of **Gestational Thrombocytopenia or Immune Thrombocytopenia) (ITP),** or confirmed diagnosis of **Hypertensive Disorders of Pregnancy (e.g. preeclampsia):**
        - i. **If concern for an underlying disorder of hemostasis or DIC (as described above),** then it may be reasonable to avoid neuraxial procedures (Class IIb, Level C-LD)
        - ii. **If the platelet count is ≥ 70,000 x $10^6$/L,** then there is likely to be a low risk of spinal epidural hematoma and it is reasonable to proceed with a neuraxial procedure if clinically indicated (Class IIa, Level C-LD)
        - iii. **If the platelet count is between 50,000 and 70,000 x $10^6$/L,** then there may be scenarios when competing risks/benefits justify proceeding with a neuraxial procedure. (Class IIb, Level C-LD)

[*]Assumes patient has no additional risk factors. Clinical context and competing risks might include, but are not limited to, the presence of high-risk comorbidities or difficult airway, the need for urgent or emergent general anesthesia, or the choice of neuraxial technique (i.e. spinal versus epidural anesthetic).

iv. **If the platelet count is < 50,000 x $10^6$/L,** then there may likely be an increased risk of spinal epidural hematoma compared to a platelet count ≥ 70,000 x $10^6$/L and it may be reasonable to avoid neuraxial procedures. (Class IIb Level C-LD)

The optimal frequency of laboratory testing in a pregnant patient with preeclampsia prior to neuraxial procedure is unknown. Published recommendations range from 6 to ≥ 12 hours,[62,63] and clinical practices vary even more.[64] Some retrospective evidence suggests that thrombocytopenia in patients with preeclampsia is rare, and that platelet count changes from above 100,000 x $10^6$/L to below 100,000 x $10^6$/L within the 72 hours prior to delivery are even rarer.[65] Patients with HELLP syndrome appear to be the most likely subgroup to experience a rapid decline in platelet count. Whether HELLP is a distinct entity or a severe form of preeclampsia remains unclear, particularly since up to 15% of afflicted patients lack hypertension.[63] Laboratory values that define HELLP syndrome include:

- Lactate dehydrogenase (LDH) ≥ 600 IU/L ***and***
- Aspartate Aminotransferase (AST) or Alanine Aminotransferase (ALT) elevated more than twice the upper limit of normal ***and***
- Platelet count less than 100,000 x $10^6$/L

Acknowledging that some patients with HELLP syndrome may particularly benefit from an early epidural or CSE procedure before the platelet drops precipitously, the expert panel agreed that it may be reasonable to verify the platelet count within 6 hours of the planned neuraxial procedure.

a. **If clinical scenario is consistent with HELLP syndrome,** then it may be reasonable to verify platelet count within 6 hours of the planned neuraxial procedure (Class IIb, Level C- EO)

**B) The obstetric patient *without a known etiology of thrombocytopenia*[*]**

Some obstetric patients present to the labor and delivery floor with newly recognized thrombocytopenia. This heterogeneous group of patients include those that were known to be thrombocytopenic in the antepartum period (but may not have received a formal diagnosis), those with new thrombocytopenia, and patients without prior platelet counts available for comparison. When assessing the appropriateness of neuraxial anesthesia in an obstetric patient with thrombocytopenia:

1. Screen patient for a possible underlying disorder of hemostasis (Box 2) and visible signs of disseminated intravascular coagulopathy (DIC) such as bleeding from IV sites, catheters, wounds, or new mucocutaneous bleeding.
    a. **If concern for an underlying disorder of hemostasis or DIC (as described above),** then it may be reasonable to avoid neuraxial procedures (Class IIb, Level C-LD)
    b. **If platelet count is < 70,000 x $10^6$/L,** then additional (hematologic) work-up may be beneficial prior to proceeding with neuraxial anesthesia. (Class IIb, Level C-EO)

[*] Assumes patient has no additional risk factors. Clinical context and competing risks might include, but are not limited to, the presence of high-risk comorbidities or difficult airway, the need for urgent or emergent general anesthesia, or the choice of neuraxial technique (i.e. spinal versus epidural anesthetic).

c. **If the platelet count is ≥ 70,000 x $10^6$/L without history of or current bleeding,** then there is likely to be a low risk for spinal epidural hematoma and it is reasonable to proceed with neuraxial procedure if clinically indicated* (Class IIa, Level C-LD)

**Other Recommendations:**

1. **Aspirin, Neuraxial, and Thrombocytopenia**.
    a. The taskforce members concluded that there was insufficient evidence to make a recommendation about performing neuraxial procedures in thrombocytopenic obstetric patients taking aspirin.
2. **Other Laboratory Testing and Thrombocytopenia Prior to Neuraxial Procedure**
    a. The taskforce members concluded that there was insufficient evidence to make a recommendation about the use of additional laboratory tests (e.g., PT, aPTT, TEG, ROTEM, and PFA) to aid in decision making regarding the safety of neuraxial anesthesia in obstetric patients with thrombocytopenia.

## I. Quality Assurance/Quality Improvement

Improvements in the care of a thrombocytopenic obstetric patient depend upon optimal interdisciplinary communication, iterative systems that identify patients at risk, and a culture that promotes non-judgmental debriefings of cases. In addition, large-scale acquisition of

*Assumes patient has no additional risk factors. Clinical context and competing risks might include, but are not limited to, the presence of high-risk comorbidities or difficult airway, the need for urgent or emergent general anesthesia, or the choice of neuraxial technique (i.e. spinal versus epidural anesthetic).

better outcome data is needed. Specific recommendations at the local, national and international level include:

1. Interdisciplinary knowledge of the etiologies of thrombocytopenia in pregnancy, and the associated protocols related to neuraxial procedures
2. Early consultation with anesthesiology and hematology experts during pregnancy in thrombocytopenic patients to coordinate treatment plan and address patient expectations
3. Institutional pathways to quickly identify patients with suspected spinal epidural hematoma and obtain urgent magnetic resonance imaging (MRI) and follow-up care
4. Population level data on complications of neuraxial anesthesia in thrombocytopenic patients, such as: a national or international registry to catalogue neuraxial procedures in thrombocytopenic patients (all subpopulations) and occurrences of spinal epidural hematomas

## Concluding Remarks

The best available evidence indicates that the risk of spinal epidural hematoma with a platelet count $\geq 70{,}000 \times 10^6$/L is likely to be very low in an obstetric patient without additional risk factors over a range of thrombocytopenia etiologies that include gestational thrombocytopenia, ITP, and hypertensive disorders of pregnancy. There may be some clinical scenarios where decisions are made to proceed with a neuraxial anesthetic at lower platelet counts. Patients with HELLP syndrome likely require closer monitoring and a more recent platelet count prior to neuraxial procedures. As there are substantial risks associated with withholding a neuraxial analgesic/anesthetic procedure in obstetric patients, every effort should be made to investigate the bleeding history and thrombocytopenia etiology prior to

admission for delivery. This approach maximizes the ability to consider potential therapies and employ shared decision-making between thrombocytopenic obstetric patients and their providers regarding the safety, benefits and putative risks associated with neuraxial anesthesia.

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**Table 1.** Society recommendations for neuraxial procedures in the setting of thrombocytopenia

| Society | Neuraxial Procedure Types | Indications to Assess Platelet Number Prior to Procedure | Platelet Count Recommendations |
|---|---|---|---|
| **Anesthesiology Societies** | | | |
| **American Society of Regional Anesthesiology and Pain Medicine (ASRA)**<br><br>**2018**[18] | Anesthesia | If heparin administered > 4 days, check platelet count prior to NB/CR | NA |
| **American Society of Anesthesiologists**<br><br>**2016**[66] | Obstetric anesthesia | The anesthesiologist's decision to order or require a platelet count should be individualized and based on a patient's history, physical examination, and clinical signs. A routine platelet count is not necessary in the healthy parturient. | NA |
| **American Society of Regional Anesthesiology and Pain Medicine (ASRA)**<br><br>**2015**[67] | Pain procedures | Check platelet count if glycoprotein IIb/IIIa receptor antagonist (abciximab, eptifibatide, tirofiban) administered | NA |
| **German Society for Anesthesiology and Intensive Care**<br><br>**2014**[37] | Anesthesia | For heparin or LMWH administered > 5 days, check platelet count prior to NB/CR | NA |
| **Association of Anaesthetists of Great** | Obstetric anesthesia | **DIC:** incompatible with neuraxial anesthesia | Risk assessment for spinal hematoma in obstetric patients: |

| | | | |
|---|---|---|---|
| **Britain and Ireland (AAGBI)**<br><br>**2013**[61] | | **Massive transfusion:** assessment of platelet function should occur in patients who have been given platelet transfusions prior to neuraxial anesthesia<br><br>**Liver failure**: assessment of coagulopathy including platelet number and function<br><br>**Uremia**: assessment of platelet number and function<br><br>**Trauma**: coagulopathy should be assessed<br><br>**Sepsis**: coagulopathy should be assessed | **Normal risk**<br>In preeclampsia, **>100,000 x $10^6$/L** within 6 hrs of NB<br>In ITP, **>75,000 x $10^6$/L** within 24 hrs of NB<br>In IUFD, coagulation tests normal within 6 hours of block<br><br>**Increased risk**<br>In preeclampsia, **75-100,000 x $10^6$/L** (stable)<br>In ITP, **50-75,000 x $10^6$/L**<br>In IUFD, no clinical tests and no coagulation studies available<br><br>**High risk**<br>In preeclampsia, **75-100,000 x $10^6$/L** (decreasing) and normal coagulation tests<br>In ITP, **20-50,000 x $10^6$/L**<br><br>**Very high risk**<br>In preeclampsia**, <75,000 x $10^6$/L** or abnormal coagulation tests or HELLP syndrome<br>In ITP, **<20,000 x $10^6$/L**<br>In IUFD, abruption or overt sepsis |
| **Sociedade Brasileira de Anestesiologia (SBA)**<br><br>**2013**[59] | Anesthesia | If heparin administered $\geq$ 5 days, check platelet count prior to NB/CR | Epidural or spinal blocks, in the absence of risk factors for bleeding, may be performed with platelet counts **> 80,000 x $10^6$/L** |

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|---|---|---|---|
| **Belgium Association for Regional Anaesthesia (BARA)**<br><br>**2011**[38] | Anesthesia | If heparin or LMWH has been administered for 5 days (or greater), check platelet count prior to NB/CR<br><br>Check platelet count if glycoprotein IIb/IIIa receptor antagonist (abciximab, eptifibatide, tirofiban) administered | NA |
| **European Society of Anesthesiology (ESA)**<br><br>**2010**[40] | Anesthesia | If heparin administered $\geq$ 5 days, check platelet count prior to NB/CR<br><br>Check platelet count if glycoprotein IIb/IIIa receptor antagonist (abciximab, eptifibatide, tirofiban) administered | NA |
| **Scandinavian Society of Anesthesiology (SCA)**<br><br>**2010**[60] | Anesthesia | For heparin given > 5 days, check platelet count prior to NB/CR<br><br>**Liver failure**: NB is contraindicated in severe hepatic dysfunction with elevated INR or platelets **< 100,000 x $10^6$/L** | Acceptable counts of normally functioning platelets depend upon the type of neuraxial block and the indication for the block:<br><br>Single shot spinal anesthesia<br>Benefit is comfort: **>100,000 x $10^6$/L**<br>Benefit is reduced morbidity: **>50,000 x $10^6$/L**<br><br>Benefit is reduced mortality: **>30,000 x $10^6$/L**<br><br>Epidural and combined spinal epidural<br>Benefit is comfort: **>100,000 x $10^6$/L**<br><br>Benefit is reduced morbidity: **>80,000 x $10^6$/L** |

| | | | |
|---|---|---|---|
| | | | Benefit is reduced mortality: **>50,000 x $10^6$/L** |
| **Transfusion Medicine Societies** | | | |
| **American Red Cross**<br><br>**2017[68]** | Diagnostic lumbar puncture | NA | Prophylactic platelet transfusion recommended for patients with a platelet count <**20,000 x $10^6$/L** |
| | Anesthesia | NA | Prophylactic platelet transfusion recommended for patients with a platelet count <**80,000 x $10^6$/L** |
| **AABB (formerly, the American Association of Blood Banks)**<br><br>**2015[69]** | Diagnostic lumbar puncture | NA | Prophylactic platelet transfusion recommended for patients having elective diagnostic lumbar puncture with a platelet count **< 50,000 x $10^6$/L** |
| **The Dutch Institute of Healthcare Improvement (CBO)**<br><br>**2011[56]** | Lumbar puncture | NA | Target value of **>20,000 x $10^6$/L** prior to LP |
| | Pediatric lumbar puncture | NA | A platelet count of **> 50,000 x $10^6$/L** in acute lymphatic leukemia (ALL) with blasts in peripheral blood<br><br>A platelet count **> 10,000 x $10^6$/L** in stable children with ALL without blasts.<br><br>A higher platelet transfusion trigger should be considered if general anesthesia cannot be used on a child undergoing a LP and/or if the physician who performs the LP is inexperienced. |
| **Italian Society of Transfusion Medicine and Immunohaema-tology** | Anesthesia and lumbar puncture | NA | Bring the platelet count to above **50,000 x $10^6$/L** |

| | | | |
|---|---|---|---|
| **(SIMTI)**<br><br>**2011**[70] | | | |
| **German Society of Transfusion Medicine**<br><br>**2009**[54] | Anesthesia | NA | Platelet transfusion is recommended as prophylaxis prior to performing epidural anesthesia if the threshold platelet count is **<80,000 x $10^6$/L**<br>and prior to spinal anesthesia<br>with a threshold count of **<50,000 x $10^6$/L** |
| | Diagnostic lumbar puncture | NA | Platelet transfusion is recommended prior to elective lumbar puncture if platelet count is **<50,000 x $10^6$/L**<br><br>For urgently necessary diagnostic procedures a platelet count of **20,000 x $10^6$/L**<br>is considered sufficient unless there are symptoms of hemorrhage.<br><br>In patients with severe sepsis for whom a lumbar puncture is absolutely necessary for the<br>diagnosis (e.g. if meningococcal sepsis is suspected), LP may be performed independent of platelet count. If platelet count is **<10,000 x $10^6$/L**<br>platelet transfusion should be performed. |
| **French Safety Agency for Health Products (AFSSaPS)**<br><br>**2005**[71] | Anesthesia | NA | A platelet count of **≥50,000 x $10^6$/L**<br>is sufficient for spinal anesthesia.<br><br>A platelet count of **≥80,000 x $10^6$/L**<br>is sufficient for epidurals. |

| | | | |
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| | | | Other hemorrhagic risk factors must be taken<br>into account, as well as the progressive nature of the thrombocytopenia. |
| **Hematology and Oncology Societies** | | | |
| **American Society of Clinical Oncology**<br><br>**2018**[72] | Lumbar puncture | NA | Platelet count of **40,000 x $10^6$/L to 50,000 x $10^6$/L**<br>is sufficient to perform "major invasive procedures" |
| **British Committee for Standards in Haematology**<br><br>**2017**[39] | Lumbar puncture | NA | Consider performing lumbar puncture above the platelet count threshold of **40,000 x $10^6$/L** |
| | Insertion/removal of epidural catheter | NA | Consider performing epidural catheter insertion or removal above the platelet count threshold of **80,000 x $10^6$/L** |
| **British Committee for Standards in Haematology**<br><br>**2016**[57] | Pediatric lumbar puncture | NA | Threshold for platelet transfusion prior to LP is **<40,000 x $10^6$/L**<br><br>"It is accepted that prior to LP some clinicians will transfuse platelets at higher counts (e.g. **50,000 x $10^6$/L**) in clinically unstable children, non ALL patients, or for the first LP in newly diagnosed ALL patients to avoid haemorrhage and cerebrospinal fluid contamination with blasts, or at lower counts (**≤20,000 x $10^6$/L**) in<br>stable patients with ALL, depending on the clinical situation." |

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| **British Society for Haematology**<br><br>**2015[73]** | Obstetric anesthesia in Acute Myeloid Leukemia | NA | Epidural anesthesia should be avoided in a woman who is significantly thrombocytopenic (**<80,000 x $10^6$/L)** |
| **American Society of Hematology**<br><br>**2013[74]** | Obstetric anesthesia | NA | "The minimum platelet count for the placement of regional anesthesia is unknown and local practices may differ. Many anesthesiologists will place a regional anesthetic if the platelet count is **≥ 80,000 x $10^6$/L"** |
| **C17 Children's Cancer and Blood Disorders Council of Canada**<br><br>**2011[55]** | Pediatric lumbar puncture | NA | Threshold for stable patients requiring a LP to receive prophylactic platelet transfusion is **>20,000 x $10^6$/L.**<br><br>Transfusions to a higher level may be required for patients with a high fever, rapid fall in platelet count, concomitant coagulopathy, critically ill patients and those with impaired platelet function.<br><br>Transfusions at a higher level (**>50,000 x $10^6$/L**) are recommended for diagnostic LP for newly diagnosed patients with leukemia |

| Obstetric, Radiology and Neurology Medical Societies | | | |
|---|---|---|---|
| **The American College of Obstetricians and Gynecologists (ACOG)**<br><br>**2019[1]** | Obstetric anesthesia | NA | NB acceptable in **≥70,000 x $10^6$/L** if count is stable, function is normal, no other acquired or congenital coagulopathies present, and no antiplatelet or antithrombotic therapy |
| **Alzheimer's Association**<br><br>**2017[75]** | Diagnostic lumbar puncture | Obtain platelet count prior to LP | Platelets **> 40,000 x $10^6$/L** |
| **Society of Interventional Radiology**<br><br>**2019[76]** | Lumbar puncture | Platelet count not routinely recommended | Threshold platelet count: Transfuse if **<20,000 x $10^6$/L** |
| | Epidural injection | Platelet count is routinely recommended | Threshold platelet count: Transfuse if **<50,000 x $10^6$/L** |

NB= neuraxial block; CR = catheter removal; ITP = idiopathic thrombocytopenia purpura; NSAID = nonsteroidal anti-inflammatory drugs; ASA = aspirin; LMWH = low molecular weight heparin; LP = lumbar puncture; NA = Not discussed in guidelines, IUFD= intrauterine fetal demise

**Table 2**. Practitioner Surveys assessing platelet cutoffs for performing neuraxial procedures

| **Anesthesiologist Surveys: Willingness to Perform Neuraxial Procedures in Thrombocytopenia in Pregnancy** | | | | |
|---|---|---|---|---|
| **Study** | **Number of responders** | **Patient population** | **Platelet count ($10^6$/L)** | **Percentage who *Would Perform* Procedure** |
| **Beilin** (1996) | N= 113 Academic practitioners<br><br>N= 94 Private practitioners | *Otherwise healthy* | 100,000-150,000 | 100% Academic practitioners<br>100% Private practitioners |
| | | | 80,000-99,000 | 66% Academic practitioners<br>55% Private practitioners |
| | | | 50,000-79,000 | 16% Academic practitioners<br>9% Private practitioners |
| | | | <50,000 | 2% Academic practitioners<br>0% Private practitioners |
| **Wee** (2002) | N=213 Obstetric anesthesiologists | *Immune Thrombocytopenia* | >100,000 | 96% Epidural procedure<br>96% Spinal procedure |
| | | | 80,000-100,000 | 64% Epidural procedure<br>74% Spinal procedure |
| | | | 50,000-79,000 | 22% Epidural procedure<br>31% Spinal procedure |
| | | | <50,000 | 4% Epidural procedure<br>9% Spinal procedure |
| | | | After correction of platelet count | 76% Epidural procedure<br>79% Spinal procedure |
| | N= 224 Obstetric anesthesiologists | *Preeclampsia* | >100,000 | 98% Epidural procedure<br>98% Spinal procedure |
| | | | 80,000-100,000 | 72% Epidural procedure<br>78% Spinal procedure |
| | | | 50,000-79,000 | 22% Epidural procedure<br>30% Spinal procedure |
| | | | <50,000 | 4% Epidural procedure<br>7% Spinal procedure |
| | | | After correction of platelet count | 72% Epidural procedure<br>74% Spinal procedure |
| **Breen** (2000) | N= 308 Community anesthesiologists<br><br>N= 204 University anesthesiologists | Not specified | Would place epidural catheter at 50,000 | 14.6% Clinical anesthesiologists<br>16.2% University anesthesiologists |
| | | *Minimum platelet count you will accept and still provide epidural analgesia*<br>*Clinical-based anesthesiologists: 80,600 +/- 18,800 (n=308)*<br>*University-based anesthesiologist: 79,500 +/- 18,000 (n=204)* | | |

| | | | | |
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| **Staikou** (2014) | N= 341 | *"No signs or history of bleeding"* | ***"At which platelet count you will NOT consider regional analgesia or anesthesia"*** | |
| | | | <100,000 | 21.4% |
| | | | <80,000 | 60.4% |
| | | | <50,000 | 89.4% |
| | | | Would not do if significant drop from last platelet count | 10.6% |

**Table 3. Common Etiologies of Thrombocytopenia during Pregnancy and Postpartum**

| Disease | Incidence during Pregnancy (%) | Diagnostic Features | Laboratory Findings | Clinical Symptoms and Physical Exam | Pathophysiology |
|---|---|---|---|---|---|
| Gestational Thrombo-cytopenia | 5-11 | Common onset during late second or third trimester, Normal platelet count outside of pregnancy | Platelets >75,000 x $10^6$/L | Typically normal | Unclear |
| ITP | <1 | Onset any trimester, Thrombocytopenia outside of pregnancy possible | Platelets <100,000 x $10^6$/L ± large platelets on PBS | Rarely may have signs of bleeding, bruising, petechiae | Antibody induced peripheral platelet destruction and decreased bone marrow production |
| Preeclampsia | 5-8 | Onset in late second or third trimester (>20 weeks gestation) | ≥300 mg urine protein in 24 hours or protein/creatinine ratio of ≥ 0.3 or end organ injury | Systolic BP ≥140mmHg or Diastolic BP≥ 90mmHg | Systemic endothelial dysfunction<br>Inadequate placentation |
| HELLP syndrome | <1 | 70% onset in late second or third trimester, 30% onset postpartum | MAHA<br>Elevated LFTs<br>Elevated LDH | Any or all signs of preeclampsia may be present, in 15-20% of cases no hypertension or proteinuria is present | Systemic endothelial dysfunction<br>Inadequate placentation |

Abbreviations: PBS = peripheral blood smear, BP = blood pressure, MAHA = microangiopathic hemolytic anemia, AFLP = acute fatty liver of pregnancy, PT = prothrombin time, PTT = partial thromboplastin time, LFTs = liver function tests, RUQ = right upper quadrant, LDH = lactate dehydrogenase, WBC = white blood cells

**Table 4. Laboratory testing assessments**

| Test | Assay Principle | Clinical application | Limitations |
|---|---|---|---|
| Complete blood count (CBC) | Whole blood assay based on the Coulter principle or electrical impendence that provides quantitative assessment of platelet count among other parameters | Assesses quantitative number of platelets | Cannot assess for qualitative disorders |
| Peripheral blood smear (PBS) | Blood film that involves cytology of peripheral blood cells smeared on a slide. | To evaluate for specific causes of thrombocytopenia with characteristic patterns on peripheral blood smear such as thrombotic microangiopathies, congenital macrothrombocytopenia, pseudothrombocytopenia (clumping). | Morphologic review by hematologists, pathologist, or expert laboratory technician required<br><br>Assesses for specific causes of thrombocytopenia but does not assess bleeding risk |
| Prothrombin (PT) and Partial Thromboplastin time (aPTT) | One stage clot based assay based upon on the time required for a fibrin clot to form after the addition of an activator to phospholipids, calcium, and platelet poor plasma. | To assess secondary hemostasis pathways including deficiencies or inhibition of coagulation factor cascade | Does not assess for qualitative or quantitative platelet disorders |
| Platelet function analyzer - 100 (PFA-100) | Assess platelet plug formation by measuring the time required for citrated whole blood to occlude a membrane impregnated with either collagen and epinephrine (PFA-Epi) or collagen and adenosine 5'diphosphate (PFA-ADP). | Screening for platelet function defects | Prolongation of both phases of the PFA-100 (PFA-Epi and PFA-ADP) may be found in patients with thrombocytopenia (PLT < 100,000 x $10^6$/L), anemia (Hb <10g/dL), or a significant qualitative platelet defect<br><br>Affected by anemia, |

| | | | |
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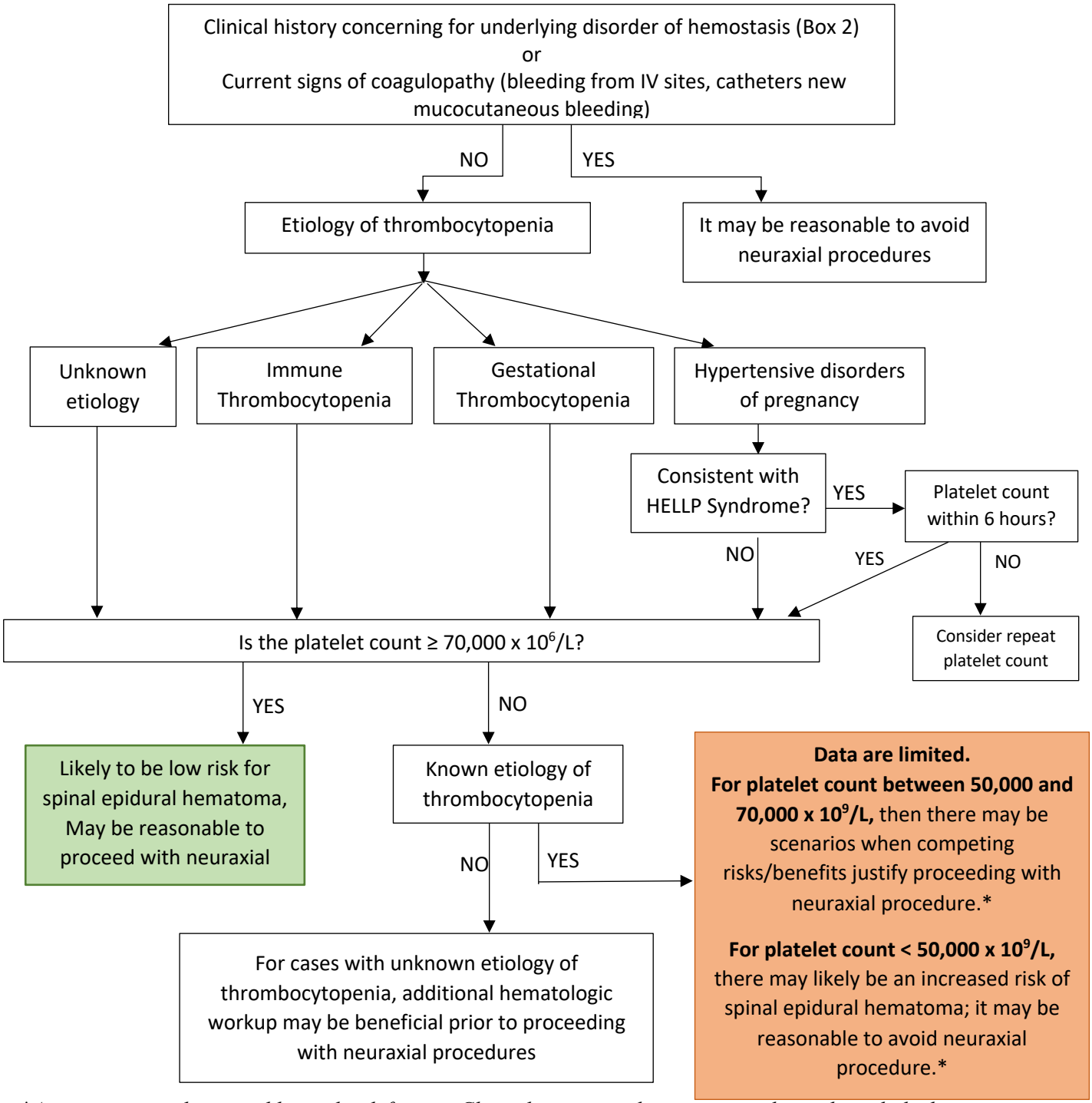
| | | | thrombocytopenia and antiplatelet medications<br><br>Lack of specificity and predictive value for any particular disorder and absence of correlation with bleeding risk. |
| Platelet aggregation study | Measures platelet agglutination and aggregation in response to different weak and strong agonists | Used in specialized centers for the evaluation of acquired and inherited platelet function defects | Affected by thrombocytopenia<br><br>Limited correlation with bleeding phenotype in patients with mild platelet function disorders |
| Viscoelastic testing<br>- thromboelastography (TEG)<br>- rotational thromboelastometry (ROTEM) | Based on viscoelastic properties of a clot formed when applying a rotational force providing quantitative information on clot development, stabilization and dissolution | Validated in guiding transfusion strategy in trauma and surgical patients | Limited correlation with clinical outcomes in patients with acquired and inherited bleeding disorders<br><br>Very limited evidence for using viscoelastic testing prior to placing neuraxial procedures in thrombocytopenic parturients |

**Figure 1.** Thrombocytopenia in Obstetric Patients: Assessment of Whether to Proceed with a Neuraxial procedure




**Assumes patient has no additional risk factors. Clinical context and competing risks might include, but are not limited to, the presence of high-risk comorbidities or difficult airway, the need for urgent or emergent general anesthesia, or the choice of neuraxial technique (i.e. spinal versus epidural anesthetic).*

[a] This consensus statement is not intended to set out a legal standard of care and does not replace medical care or the judgement of the responsible medical professional considering all of the circumstances presented by an individual patient. This statement is not intended to ensure a successful patient outcome in every situation and is not a guarantee of any specific outcome.

Box 1. Maternal and Fetal Risks Related to General Anesthesia

Maternal Risks

- Serious adverse events related to induction of general anesthesia (eg, respiratory or cardiac complications, cardiac arrest)[77]
- Failed tracheal intubation[17,78,79]
- Cerebrovascular injury from a severe hypertensive response to tracheal intubation in women with comorbidities (eg, preeclampsia, cardiac disease)[80]
- Intraoperative uterine atony and/or increased obstetric hemorrhage[81-83]
- Inability to provide neuraxial opioids limiting opioid-sparing postcesarean analgesia[84]
- Persistent pain after delivery[85,86]

Fetal Risks

- Respiratory depression at delivery, Apgar <7 at 5 minutes, and admission to neonatal intensive care unit in urgent cases
- In utero exposure to induction/inhalational agents with potential neurobehavioral impact
- Reduced benefits of immediate breastfeeding with decreased likelihood of exclusive breastfeeding

Adapted from Leffert L, Butwick A, Carvalho B, et al. The Society for Obstetric Anesthesia and Perinatology Consensus Statement on the Anesthetic Management of Pregnant and Postpartum Women Receiving Thromboprophylaxis or Higher Dose Anticoagulants. *Anesth Analg.* 2018;126(3):928-944.

Box 2. Clinical Screening for an Possible Underlying Disorder of Hemostasis in the Adult Patient *

A positive screening result* comprises the following circumstances:

- Heavy menstrual bleeding since menarche (suggested by bleeding >7 days, soaking through a menstrual pad or tampon every 1-2 hours, passing blood clots >2.5cm)
- Hemostatic challenges not related to the procedure itself, organ, or vascular damage (one of the following)
    - Postpartum hemorrhage
    - Surgery-related bleeding
    - Bleeding associated with dental work
- Spontaneous major bleed not associated with anatomic lesion/trauma especially if requiring transfusion (one of the following)
    - GI bleeding
    - Intramuscular or intrarticular bleeding
    - CNS bleeding
- Bleeding symptoms (two of the following)
    - Frequent epistaxis outside of pregnancy (>5yr or >10mins)
    - Easy bruising (requiring medical attention)
    - Prolonged bleeding after minor injury (>5/yr or >5mins)
- Family history of bleeding symptoms/disorder

*Patients with a positive screening result should be considered for further evaluation, including consultation with a hematologist and focused laboratory testing