Practice Guidelines for Obstetric Anesthesia

An Updated Report by the American Society of Anesthesiologists Task Force on Obstetric Anesthesia and the Society for Obstetric Anesthesia and Perinatology[*]

PRACTICE guidelines are systematically developed recommendations that assist the practitioner and patient in making decisions about health care. These recommendations may be adopted, modified, or rejected according to clinical needs and constraints, and are not intended to replace local institutional policies. In addition, practice guidelines developed by the American Society of Anesthesiologists (ASA) are not intended as standards or absolute requirements, and their use cannot guarantee any specific outcome. Practice guidelines are subject to revision as warranted by the evolution of medical knowledge, technology, and practice. They provide basic recommendations that are supported by a synthesis and analysis of the current literature, expert and practitioner opinion, open forum commentary, and clinical feasibility data.

This document updates the " Practice Guidelines for Obstetric Anesthesia: An Updated Report by the ASA Task Force on Obstetric Anesthesia," adopted by ASA in 2006 and published in 2007.[†]

[*] Supplemental Digital Content is available for this article. Direct URL citations appear in the printed text and are available in both the HTML and PDF versions of this article. Links to the digital files are provided in the HTML text of this article on the Journal's Web site (www.anesthesiology.org). A complete bibliography used to develop these updated Guidelines, arranged alphabetically by author, is available as Supplemental Digital Content, http://links.lww.com/ALN/___

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[†] Practice Guidelines for Obstetric Anesthesia: an Updated Report by the American Society of Anesthesiologists Task Force on Obstetric Anesthesia. Anesthesiology 2007; 106:843-863.

Methodology

A. Definition of Perioperative Obstetric Anesthesia

For the purposes of these updated Guidelines, *obstetric anesthesia* refers to peripartum anesthetic and analgesic activities performed during labor and vaginal delivery, cesarean delivery, removal of retained placenta, and postpartum tubal ligation.

B. Purposes of the Guidelines

The purposes of these Guidelines are to enhance the quality of anesthetic care for obstetric patients, improve patient safety by reducing the incidence and severity of anesthesia-related complications, and increase patient satisfaction.

C. Focus

These Guidelines focus on the anesthetic management of pregnant patients during labor, non-operative delivery, operative delivery, and selected aspects of postpartum care and analgesia (*i.e.*, neuraxial opioids for postpartum analgesia after neuraxial anesthesia for cesarean delivery). The intended patient population includes, but is not limited, to intrapartum and postpartum patients with uncomplicated pregnancies or with common obstetric problems. The Guidelines do not apply to patients undergoing surgery during pregnancy, gynecological patients, or parturients with chronic medical disease (*e.g.*, severe cardiac, renal or neurological disease). In addition, these Guidelines do not address: (1) postpartum analgesia for vaginal delivery, (2) analgesia after tubal ligation, or (3) postoperative analgesia after general anesthesia (GA) for cesarean delivery.

D. Application

These Guidelines are intended for use by anesthesiologists. They also may serve as a resource for other anesthesia providers and health care professionals who advise or care for patients who will receive anesthetic care during labor, delivery, and the immediate postpartum period.

E. Task Force Members and Consultants

In 2014, the ASA Committee on Standards and Practice Parameters requested that the updated Guidelines published in 2007 be re-evaluated. This current update consists of a literature evaluation and the reporting of new survey findings of expert consultants and ASA members. A summary of recommendations is found in Appendix 1.

This update was developed by an ASA appointed Task Force of 12 members, consisting of anesthesiologists in both private and academic practices from various geographic areas of the United States, and consulting methodologists from the ASA Committee on Standards and Practice Parameters. The Task Force developed these updated Guidelines by means of a multi-step process. First, original published research studies from peer-reviewed journals published subsequent to the previous update were reviewed. Second, a panel of expert consultants was asked to (1) participate in opinion surveys on the effectiveness of various anesthetic management strategies and (2) review and comment on a draft of the update developed by the Task Force. Third, survey opinions about the Guideline recommendations were solicited from a random sample of active members of the ASA. Finally, all available information was used to build consensus within the Task Force to finalize the update.

F. Availability and Strength of Evidence

Preparation of these Guidelines followed a rigorous methodological process. Evidence was obtained from two principal sources: scientific evidence and opinion-based evidence.

Scientific Evidence:

Scientific evidence used in the development of these updated Guidelines is based on cumulative findings from literature published in peer-reviewed journals. Literature citations are obtained from PubMed and other healthcare databases, direct internet searches, Task Force members, liaisons with other organizations and from manual searches of references located in reviewed articles.

Findings from the aggregated literature are reported in the text of the Guidelines by evidence category, level, and direction. Evidence categories refer specifically to the strength and quality of the *research design* of the studies. Category A evidence represents results obtained from randomized-controlled trials (RCTs), and Category B evidence represents observational results obtained from non-randomized study designs or RCTs without pertinent comparison groups. When available, Category A evidence is given precedence over Category B evidence for any particular outcome. These evidence categories are further divided into evidence levels. Evidence levels refer specifically to the strength and quality of the summarized study *findings* (*i.e.*, statistical findings, type of data, and the number of studies reporting/replicating the findings within the evidence categories). In this document, only the highest level of evidence is included in the summary report for each intervention-outcome pair, including a directional designation of benefit, harm, or equivocality for each outcome.

Category A: RCTs report comparative findings between clinical interventions for specified outcomes. Statistically significant ($p < 0.01$) outcomes are designated as either beneficial (B) or harmful (H) for the patient; statistically nonsignificant findings are designated as equivocal (E).

Level 1: The literature contains a sufficient number of RCTs to conduct meta-analysis,[‡] and meta-analytic findings from these aggregated studies are reported as evidence.

Level 2: The literature contains multiple RCTs, but the number of RCTs is not sufficient to conduct a viable meta-analysis for the purpose of these updated Guidelines. Findings from these RCTs are reported separately as evidence.

Level 3: The literature contains a single RCT and findings are reported as evidence.

Category B: Observational studies or RCTs without pertinent comparison groups may permit *inference* of beneficial or harmful relationships among clinical interventions and clinical outcomes. Inferred findings are given a directional designation of beneficial (B), harmful (H), or

[‡] All meta-analyses are conducted by the ASA methodology group. Meta-analyses from other sources are reviewed but not included as evidence in this document.

equivocal (E). For studies that report statistical findings, the threshold for significance is $p < 0.01$.

Level 1: The literature contains observational comparisons (*e.g.*, cohort, case-control research designs) with comparative statistics between clinical interventions for a specified clinical outcome.

Level 2: The literature contains non-comparative observational studies with associative statistics (*e.g.*, relative risk, correlation, sensitivity/specificity).

Level 3: The literature contains noncomparative observational studies with descriptive statistics (*e.g.*, frequencies, percentages).

Level 4: The literature contains case reports.

Insufficient Literature: The *lack* of sufficient scientific evidence in the literature may occur when the evidence is either unavailable (*i.e.*, no pertinent studies found) or inadequate. Inadequate literature cannot be used to assess relationships among clinical interventions and outcomes because a clear interpretation of findings is not obtained due to methodological concerns (*e.g.*, confounding of study design or implementation), or the study does not meet the criteria for content as defined in the "Focus" of the Guidelines.

Opinion-Based Evidence:

All opinion-based evidence (*e.g.*, survey data, internet-based comments, letters, and editorials) relevant to each topic was considered in the development of these updated Guidelines. However, only the findings obtained from formal surveys are reported in the current update. Identical surveys were distributed to expert consultants and a random sample of ASA members.

Category A: Expert Opinion. Survey responses from Task Force-appointed expert consultants are reported in summary form in the text, with a complete listing of consultant survey responses reported in Appendix 3.

Category B: Membership Opinion. Survey responses from active ASA members are reported in summary form in the text, with a complete listing of ASA member survey responses reported in Appendix 3.

Survey responses from expert and membership sources are recorded using a 5-point scale and summarized based on median values.[§]

Strongly Agree:	Median score of 5 (At least 50% of the responses are 5)
Agree:	Median score of 4 (At least 50% of the responses are 4 or 4 and 5)
Equivocal:	Median score of 3 (At least 50% of the responses are 3, or no other response category or combination of similar categories contain at least 50% of the responses)
Disagree:	Median score of 2 (At least 50% of responses are 2 or 1 and 2)
Strongly Disagree:	Median score of 1 (At least 50% of responses are 1)

Category C: Informal Opinion. Open-forum testimony obtained during development of these Guidelines, Internet-based comments, letters and editorials are all informally evaluated and discussed during the formulation of Guideline recommendations. When warranted, the Task Force may add educational information or cautionary notes based on this information.

Guidelines:

Perianesthetic Evaluation and Preparation

Perianesthetic evaluation and preparation topics include: (1) a focused history and a physical examination, (2) an intrapartum platelet count, (3) a blood type and screen, and (4) perianesthetic recording of fetal heart rate patterns.

1. History and physical examination.

Literature findings: Although it is well accepted clinical practice to review medical records and conduct a physical examination, comparative studies are insufficient to directly evaluate the impact of these practices. Studies with observational findings suggest that certain patient or

[§] When an equal number of categorically distinct responses are obtained, the median value is determined by calculating the arithmetic mean of the two middle values. Ties are calculated by a predetermined formula.

clinical characteristics (*e.g.*, hypertensive disorders of pregnancy such as preeclampsia and HELLP syndrome, obesity, and diabetes) may be associated with obstetric complications *(Category B2/B3-H evidence).*[1-12]

Survey findings: The consultants and ASA members both strongly agree (1) to conduct a focused history and physical examination before providing anesthesia care and (2) that a communication system should be in place to encourage early and ongoing contact between obstetric providers, anesthesiologists, and other members of the multidisciplinary team.

2. Intrapartum Platelet Count.

Literature findings: The literature is insufficient to assess whether a routine platelet count can predict anesthesia-related complications in uncomplicated parturients. An observational study reported that platelet count and fibrinogen values are associated with the frequency of postpartum hemorrhage *(Category B2 evidence).*[13] Other observational studies and case reports suggest that a platelet count may be useful for detecting hypertensive disorders of pregnancy, such as preeclampsia; HELLP syndrome; and other conditions associated with coagulopathy *(Category B3/B4-B evidence).*[14-21]

Survey findings: The consultants and ASA members strongly agree that the anesthesiologist's decision to order or require a platelet count should be individualized and based on a patient's history (*e.g.*, preeclampsia with severe features), physical examination and clinical signs.

3. Blood Type and Screen.

Literature findings: The literature is insufficient to determine whether obtaining a blood type and screen is associated with fewer maternal anesthetic complications. In addition, the literature is insufficient to determine whether a blood cross-match is necessary for healthy and uncomplicated parturients.

Survey findings: The ASA members agree and the consultants strongly agree that (1) a routine blood cross-match is not necessary for healthy and uncomplicated parturients for vaginal or operative delivery and (2) the decision whether to order or require a blood type and screen or cross-match should be based on maternal history, anticipated hemorrhagic complications (*e.g.*, placenta accreta in a patient with placenta previa and previous uterine surgery), and local institutional policies.

4. Perianesthetic Recording of Fetal Heart Rate Patterns.

Literature findings: Studies with observational findings and case reports indicate that fetal heart rate patterns may change after the administration of neuraxial anesthetics *(Category B3/B4 evidence).*[22-29]

Survey findings: The consultants and ASA members strongly agree that fetal heart rate patterns should be monitored by a qualified individual before and after administration of neuraxial analgesia for labor.

***Recommendations* Perianesthetic Evaluation and Preparation.**

History and physical examination:

- Conduct a focused history and physical examination before providing anesthesia care.
    - This should include, but is not limited to, a maternal health and anesthetic history, a relevant obstetric history, a baseline blood pressure measurement, and an airway, heart, and lung examination, consistent with the ASA "Practice Advisory for Preanesthesia Evaluation."[**]
    - When a neuraxial anesthetic is planned, examine the patient's back.
    - Recognition of significant anesthetic or obstetric risk factors should encourage consultation between the obstetrician and the anesthesiologist.

[**] Practice Advisory for Preanesthesia Evaluation: an Updated Report by the American Society of Anesthesiologists Task Force on Preanesthesia Evaluation. Anesthesiology 2012; 116:522-538.

- A communication system should be in place to encourage early and ongoing contact between obstetric providers, anesthesiologists, and other members of the multidisciplinary team.

Intrapartum platelet count:

- The anesthesiologist's decision to order or require a platelet count should be individualized and based on a patient's history (*e.g.*, preeclampsia with severe features), physical examination and clinical signs.[††]
    - A routine platelet count is not necessary in the healthy parturient.

Blood type and screen:

- A routine blood cross-match is not necessary for healthy and uncomplicated parturients for vaginal or operative delivery.
- The decision whether to order or require a blood type and screen or cross-match should be based on maternal history, anticipated hemorrhagic complications (*e.g.*, placenta accreta in a patient with placenta previa and previous uterine surgery), and local institutional policies.

Perianesthetic recording of fetal heart rate patterns:

- Fetal heart rate patterns should be monitored by a qualified individual before and after administration of neuraxial analgesia for labor.
    - *Continuous* electronic recording of fetal heart rate patterns may not be necessary in every clinical setting and may not be possible during initiation of neuraxial anesthesia. [‡‡]

[††] A specific platelet count predictive of neuraxial anesthetic complications has not been determined

[‡‡] American College of Obstetricians and Gynecologists: ACOG Practice Bulletin No. 106: Intrapartum fetal heart rate monitoring: nomenclature, interpretation, and general management principles. Obstet Gynecol. 2009 Jul;114(1):192-202.

Aspiration Prevention

Aspiration Prevention includes: (1) clear liquids, (2) solids, and (3) antacids, H_2 receptor antagonists and metoclopramide.

1. Clear Liquids.

Literature findings: There is insufficient published literature to examine the relationship between fasting times for clear liquids and the risk of emesis/reflux or pulmonary aspiration during labor.

Survey findings: The ASA members agree and the consultants strongly agree that (1) oral intake of moderate amounts of clear liquids may be allowed for uncomplicated laboring patients and (2) the uncomplicated patient undergoing elective surgery (*e.g.*, scheduled cesarean delivery or postpartum tubal ligation) may have moderate amounts of clear liquids up to 2 h before induction of anesthesia.

2. Solids.

Literature findings: A specific fasting time for solids that is predictive of maternal anesthetic complications has not been determined. There is insufficient published literature to address the safety of *any* particular fasting period for solids in obstetric patients.

Survey findings: The consultants and ASA members strongly agree that (1) the patient undergoing elective surgery (*e.g.*, scheduled cesarean delivery or postpartum tubal ligation) should undergo a fasting period for solids of 6 to 8 hours depending on the type of food ingested (*e.g.*, fat content); (2) laboring patients with additional risk factors for aspiration (*e.g.*, morbid obesity, diabetes, difficult airway) or patients at increased risk for operative delivery (*e.g.*, nonreassuring fetal heart rate pattern) may have further restrictions of oral intake, determined on a case-by-case basis; and (3) solid foods should be avoided in laboring patients.

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3. Antacids, H_2 Receptor Antagonists, and Metoclopramide.

Literature findings: RCTs indicate that preoperative non-particulate antacids (*e.g.*, sodium citrate, sodium bicarbonate) are associated with higher gastric pH values during the peripartum period *(Category A2-B evidence),*[30-33] and are equivocal regarding gastric volume *(Category A2-E evidence).*[30,31] Randomized placebo-controlled trials indicate that H_2 receptor antagonists are associated with higher gastric pH values in obstetric patients *(Category A2-B evidence),* and are equivocal regarding gastric volume *(Category A2-E evidence).*[34-36] Randomized placebo-controlled trials indicate that metoclopramide is associated with reduced peripartum nausea and vomiting*(Category A2-B evidence).*[37-41] Literature is not available that examines the relationship between reduced gastric acidity and the frequency of pulmonary aspiration, emesis, morbidity, or mortality in obstetric patients who have aspirated gastric contents.

Survey findings: The consultants and ASA members both agree that before surgical procedures (*e.g.,* cesarean delivery, postpartum tubal ligation), consider the timely administration of non-particulate antacids, H_2 receptor antagonists, and/or metoclopramide for aspiration prophylaxis.

Recommendations for aspiration prevention.[§§]

Clear liquids:

- The oral intake of moderate amounts of clear liquids may be allowed for uncomplicated laboring patients.
- The uncomplicated patient undergoing elective surgery may have clear liquids up to 2 h before induction of anesthesia.
    - Examples of clear liquids include, but are not limited to water, fruit juices without pulp, carbonated beverages, clear tea, black coffee, and sports drinks.

[§§] The Task Force recognizes that in laboring patients the timing of delivery is uncertain; therefore adherence to a predetermined fasting period before non-elective surgical procedures is not always possible

- The volume of liquid ingested is less important than the presence of particulate matter in the liquid ingested.

- Laboring patients with additional risk factors for aspiration (*e.g.*, morbid obesity, diabetes, difficult airway), or patients at increased risk for operative delivery (*e.g.*, nonreassuring fetal heart rate pattern) may have further restrictions of oral intake, determined on a case-by-case basis.

Solids:

- Solid foods should be avoided in laboring patients.
- The patient undergoing elective surgery (*e.g*., scheduled cesarean delivery or postpartum tubal ligation) should undergo a fasting period for solids of 6 to 8 hours depending on the type of food ingested (*e.g.*, fat content). [***]

Antacids, H_2 Receptor Antagonists, and Metoclopramide:

- Before surgical procedures (*e.g.*, cesarean delivery, postpartum tubal ligation), consider the timely administration of non-particulate antacids, H_2 receptor antagonists, and/or metoclopramide for aspiration prophylaxis.

Anesthetic Care for Labor and Vaginal Delivery

Anesthetic care for labor and vaginal delivery includes: (1) timing of neuraxial analgesia and outcome of labor, (2) neuraxial analgesia and trial of labor after prior cesarean delivery, and (3) anesthetic/analgesic techniques. Appendix 2 contains an overview of anesthetic care for labor and vaginal delivery. [†††]

1. Timing of Neuraxial Analgesia and Outcome of Labor.

[***] Practice guidelines for preoperative fasting and the use of pharmacologic agents to reduce the risk of pulmonary aspiration: an Updated Report by the American Society of Anesthesiologists Task Force on Preoperative Fasting. ANESTHESIOLOGY 2011; 114:495-511.

[†††] Note that statements in appendix 2 are intended to provide an overview and are not recommendations.

Literature findings: Meta-analyses of RCTs report equivocal findings for spontaneous, instrumented and cesarean delivery when comparing early administration (*i.e.*, cervical dilations of less than 4 or 5 cm) with late administration (*i.e.*, cervical dilations of greater than 4 or 5 cm) of epidural analgesia *(Category A1-E evidence).*[42-46] An RCT comparing cervical dilations of less than 2 cm with greater than or equal to 2 cm also reports equivocal findings (Category A3-E evidence).[47] Finally, RCTs comparing early versus late CSE administration report equivocal findings for cesarean, instrumented and spontaneous delivery *(Category A2-E evidence).*[48,49]

Survey findings: The consultants and ASA members strongly agree to (1) provide patients in early labor (*i.e.*, < 5 cm dilation) the option of neuraxial analgesia when this service is available; (2) offer neuraxial analgesia on an individualized basis; and (3) not withhold neuraxial analgesia on the basis of achieving an arbitrary cervical dilation.

2. Neuraxial Analgesia and Trial of Labor after Prior Cesarean Delivery.

Literature findings: Nonrandomized comparative studies are equivocal regarding mode of delivery, duration of labor, and adverse outcomes when epidural analgesia is used in a trial of labor for previous cesarean delivery patients *(Category B1-E evidence).*[50-54]

Survey findings: The consultants and ASA members strongly agree (1) to offer neuraxial techniques to patients attempting vaginal birth after previous cesarean delivery and (2) that for these patients, it is appropriate to consider early placement of a neuraxial catheter that can be used later for labor analgesia, or for anesthesia in the event of operative delivery.

3. Analgesia/Anesthetic Techniques.

Considerations for analgesic/anesthetic techniques include: (a) early insertion of a neuraxial (*i.e.*, spinal or epidural) catheter for complicated parturients, (b) continuous infusion epidural analgesia, (c) epidural local anesthetics combined with opioids, (d) higher versus lower concentrations of local anesthetics, (e) single-injection spinal opioids with or without local

anesthetics, (f) pencil-point spinal needles, and (g) combined spinal-epidural analgesia, and (h) patient-controlled epidural analgesia.

a. Early Insertion of a Neuraxial Catheter for Complicated Parturients:

Literature findings: The literature is insufficient to assess whether, when caring for the complicated parturient, the early insertion of a neuraxial catheter, with immediate or later administration of analgesia, improves maternal or neonatal outcomes.

Survey findings: The consultants and ASA members strongly agree to consider early insertion of a neuraxial catheter for obstetric (*e.g.*, twin gestation or preeclampsia) or anesthetic indications (*e.g.*, anticipated difficult airway or obesity) to reduce the need for general anesthesia if an emergent procedure becomes necessary.

b. Continuous Infusion Epidural Analgesia (CIE)

Literature findings: RCTs indicate that continuous infusion epidural (CIE) local anesthetics are associated with reduced maternal pain and discomfort compared to single-shot intravenous opioids during labor *(Category A2-B evidence)*[55,56] The literature is insufficient to evaluate CIE compared to continuous infusion of intravenous opioids. An RCT reports greater pain relief during labor for CIE when compared with intramuscular opioids *(Category A3-B evidence)*, with equivocal findings for duration of labor and mode of delivery *(Category A3-E evidence).*[57] A nonrandomized comparative study reports equivocal findings for duration of labor and mode of delivery when CIE local anesthetics are compared with single-injection spinal opioids *(Category B1-E evidence).*[58]

Survey findings: The consultants and ASA members strongly agree that (1) continuous epidural infusion may be used for effective analgesia for labor and delivery and (2) when a continuous epidural infusion of local anesthetic is selected, an opioid may be added.

c. Analgesic concentrations:

<u>*Literature findings:*</u> Meta-analyses of RCTs report improved analgesic quality[59-63] when comparing epidural local anesthetics combined with opioids versus equal concentrations of epidural local anesthetics *without opioids* for *(Category A1-B evidence).* Findings were equivocal for frequency of spontaneous delivery, hypotension, pruritus, and 1-minute Apgar scores *(Category A1-E evidence).*[60-66,68-72]

RCTs are equivocal for analgesic efficacy and duration of labor when continuous epidural infusion of *low concentrations* of local anesthetics with opioids are compared with *higher concentrations* of local anesthetics without opioids for maintenance of analgesia *(Category A2-E evidence).*[73-78] Meta-analyses of RCTs are also equivocal regarding spontaneous delivery and neonatal Apgar scores when continuous epidural infusion of low concentrations of local anesthetics with opioids are compared with higher concentrations of local anesthetics without opioids *(Category A1-E evidence).*[73-79] A lower frequency of motor block was found for lower concentrations of local anesthetics *(Category A1-B evidence).*[73-75,77-79‡‡‡] The literature is insufficient to determine the effects of epidural local anesthetics with opioids on other maternal outcomes (*e.g.*, hypotension, nausea, pruritus, respiratory depression, urinary retention).

<u>*Survey findings:*</u> The consultants and ASA members strongly agree to use dilute concentrations of local anesthetics with opioids to produce as little motor block as possible.

d. Single-injection spinal opioids with or without local anesthetics:

<u>*Literature findings:*</u> An RCT reports a longer duration of analgesia when a spinal opioid is compared with an intravenous opioid *(Category A1-B evidence).*[80] Nonrandomized comparisons are equivocal for duration of labor, mode of delivery, and other adverse outcomes such as nausea, vomiting, headache, and pruritus *(Category B1-E evidence).*[81-83] The literature is not

‡‡‡ The Task Force notes that the addition of an opioid to a local anesthetic infusion allows an even lower concentration of local anesthetic for providing equally effective analgesia.

sufficient to compare single-injection spinal opioids *with* local anesthetics *versus* single-injection spinal opioids *without* local anesthetics.

Survey findings: The consultants and ASA members agree that single-injection spinal opioids with or without local anesthetics may be used to provide effective, although time-limited, analgesia for labor when spontaneous vaginal delivery is anticipated. The ASA members agree and the consultants strongly agree that a local anesthetic may be added to a spinal opioid to increase duration and improve quality of analgesia.

f. *Pencil-point spinal needles.*

Literature findings: Meta-analysis of RCTs indicate that the use of pencil-point spinal needles reduces the frequency of postdural puncture headache when compared to cutting-bevel spinal needles *(Category A1-B evidence).*[84-88]

Survey findings: The consultants and ASA members strongly agree to use pencil-point spinal needles instead of cutting-bevel spinal needles to minimize the risk of postdural puncture headache.

f. Combined spinal-epidural analgesia (CSE).

Literature findings: Meta-analyses of RCTs report improved analgesia and a faster onset time *(Category A2-B evidence)* when combined spinal-epidural (CSE) local anesthetics with opioids are compared with epidural local anesthetics with opioids,[89-95] with equivocal findings for maternal satisfaction with analgesia, mode of delivery, hypotension, pruritus, and 1-minute Apgar scores *(Category A1-E evidence).*[89-100] Meta-analysis of RCTs report an increased frequency of motor block with CSE *(Category A1-H evidence).*[89,91,92,95,100]

Survey findings: The consultants and ASA members strongly agree that (1) if labor is expected to last longer than the analgesic effects of the spinal drugs chosen, or if there is a good possibility of operative delivery, then consider a catheter technique instead of a single injection

technique and (2) combined spinal-epidural techniques may be used to provide effective and rapid onset of analgesia for labor.

g. Patient-controlled epidural analgesia (PCEA):

Literature findings: Meta-analysis of RCTs report reduced analgesic consumption *(Category A1-B evidence)* when patient-controlled epidural analgesia (PCEA) is compared with CIE.[101-106] Meta-analysis of RCTs report equivocal findings for duration of labor, mode of delivery, motor block and 1 and 5-minute APGAR scores when PCEA is compared to CIE *(Category A1-E evidence).*[102-116] Meta-analysis of RCTs indicate greater analgesic efficacy for PCEA with a background infusion compared to PCEA without a background infusion *(Category A1-B evidence)* [117-121] and is equivocal regarding mode of delivery and frequency of motor block *(Category A1-E evidence).*[117-122]

Survey findings: The consultants and ASA members strongly agree that (1) patient-controlled epidural analgesia may be used to provide an effective and flexible approach for the maintenance of labor analgesia and (2) the use of PCEA may be preferable to fixed-rate CIE for providing fewer anesthetic interventions and reduced dosages of local anesthetics. The consultants and ASA members agree that patient-controlled epidural analgesia may be used with or without a background infusion.

Recommendations for Anesthetic Care for Labor and Vaginal Delivery:

1. Timing of Neuraxial Analgesia and Outcome of Labor.

- Provide patients in early labor (*i.e.*, < 5 cm dilation) the option of neuraxial analgesia when this service is available.
- Offer neuraxial analgesia on an individualized basis regardless of cervical dilation.
    - Reassure patients that the use of neuraxial analgesia does not increase the incidence of cesarean delivery.

2. Neuraxial Analgesia and Trial of Labor after Prior Cesarean Delivery.

- Offer neuraxial techniques to patients attempting vaginal birth after previous cesarean delivery.
- For these patients, consider early placement of a neuraxial catheter that can be used later for labor analgesia, or for anesthesia in the event of operative delivery.

3. Analgesia/Anesthetic Techniques.

a. Early insertion of a neuraxial catheter for complicated parturients:

- Consider early insertion of a neuraxial catheter for obstetric (*e.g.*, twin gestation or preeclampsia) or anesthetic indications (*e.g.*, anticipated difficult airway or obesity) to reduce the need for general anesthesia if an emergent procedure becomes necessary.
    - In these cases, the insertion of a neuraxial catheter may precede the onset of labor or a patient's request for labor analgesia.

b. Continuous infusion epidural analgesia (CIE):

- Continuous epidural infusion may be used for effective analgesia for labor and delivery.
- When a continuous epidural infusion of local anesthetic is selected, an opioid may be added to reduce the concentration of local anesthetic, improve the quality of analgesia, and minimize motor block.

c. Analgesic concentrations:

- Use dilute concentrations of local anesthetics with opioids to produce as little motor block as possible.

d. Single-injection spinal opioids with or without local anesthetics:

- Single-injection spinal opioids with or without local anesthetics may be used to provide effective, although time-limited, analgesia for labor when spontaneous vaginal delivery is anticipated.
- If labor duration is anticipated to be longer than the analgesic effects of the spinal drugs chosen, or if there is a reasonable possibility of operative delivery, then consider a catheter technique instead of a single injection technique.
- A local anesthetic may be added to a spinal opioid to increase duration and improve quality of analgesia.

e. Pencil-point spinal needles:

- Use pencil-point spinal needles instead of cutting-bevel spinal needles to minimize the risk of post-dural puncture headache.

f. Combined spinal-epidural (CSE) analgesia:

- If labor duration is anticipated to be longer than the analgesic effects of the spinal drugs chosen, or if there is a reasonable possibility of operative delivery, then consider a catheter technique instead of a single injection technique.
- CSE techniques may be used to provide effective and rapid onset of analgesia for labor.

g. Patient-controlled epidural analgesia (PCEA):

- PCEA may be used to provide an effective and flexible approach for the maintenance of labor analgesia.
- The use of PCEA may be preferable to fixed-rate CIE for administering reduced dosages of local anesthetics.
- PCEA may be used with or without a background infusion.

Removal of Retained Placenta

Analgesic/anesthetic technique consists of (1) anesthetic techniques for removal of retained placenta and (2) uterine relaxation.

Anesthetic Techniques.

Literature findings: The literature is insufficient to assess whether a particular anesthetic technique is more effective than another for removal of retained placenta.

Survey findings: The consultants and ASA members strongly agree (1) that if an epidural catheter is in place and the patient is hemodynamically stable, consider providing epidural anesthesia and (2) to assess hemodynamic status before administering neuraxial anesthesia. The consultants and ASA members agree to consider aspiration prophylaxis. The consultants and ASA members strongly agree: (1) to titrate sedation/analgesia carefully due to the potential risks of respiratory depression and pulmonary aspiration during the immediate postpartum period and (2) that in cases involving major maternal hemorrhage with hemodynamic instability, general anesthesia with an endotracheal tube may be considered in preference to neuraxial anesthesia.

Nitroglycerin for Uterine Relaxation.

Literature findings: RCTs comparing intravenous or sublingual nitroglycerin with placebo for the purpose of uterine relaxation report inconsistent findings for successful removal of retained placenta *(Category A2-E evidence).*[123-125] Observational studies and case reports indicate successful uterine relaxation and successful placental removal after intravenous or sublingual nitroglycerin administration *(Category B3/B4 evidence).*[126-130]

Survey findings: The ASA members agree and the consultants strongly agree that nitroglycerin may be used as an alternative to terbutaline sulfate or general endotracheal anesthesia with halogenated agents for uterine relaxation during removal of retained placental tissue.

Recommendations for removal of retained placenta.

Anesthetic techniques for removal of retained placenta:

- In general, there is no preferred anesthetic technique for removal of retained placenta.
    - If an epidural catheter is in place and the patient is hemodynamically stable, consider providing epidural anesthesia.
- Assess hemodynamic status before administering neuraxial anesthesia.
- Consider aspiration prophylaxis.
- Titrate sedation/analgesia carefully due to the potential risks of respiratory depression and pulmonary aspiration during the immediate postpartum period.
- In cases involving major maternal hemorrhage with hemodynamic instability, general anesthesia with an endotracheal tube may be considered in preference to neuraxial anesthesia.

Nitroglycerin for uterine relaxation:

- Nitroglycerin may be used as an alternative to terbutaline sulfate or general endotracheal anesthesia with halogenated agents for uterine relaxation during removal of retained placental tissue.
    - Initiating treatment with incremental doses of intravenous or sublingual (*i.e.*, tablet or metered dose spray) nitroglycerin may be done to sufficiently relax the uterus.

Anesthetic Care for Cesarean Delivery

Anesthetic care for cesarean delivery consists of: (1) equipment, facilities, and support personnel; (2) general, epidural, spinal, or combined spinal-epidural anesthesia; (3) intravenous fluid preloading or coloading; (4) ephedrine or phenylephrine; and (5) neuraxial opioids for postoperative analgesia after neuraxial anesthesia.

1. Equipment, Facilities, and Support Personnel.

Literature findings: The literature is insufficient to evaluate the benefit of providing equipment, facilities, and support personnel in the labor and delivery operating suite comparable to that available in the main operating suite.

Survey findings: The consultants and ASA members strongly agree that (1) equipment, facilities, and support personnel available in the labor and delivery operating suite should be comparable to those available in the main operating suite; (2) resources for the treatment of potential complications (*e.g.*, failed intubation, inadequate anesthesia, hypotension, respiratory depression, local anesthetic systemic toxicity (LAST), pruritus, vomiting) should also be available in the labor and delivery operating suite; and (3) appropriate equipment and personnel should be available to care for obstetric patients recovering from major neuraxial or general anesthesia.

2. General, Epidural, Spinal, or Combined Spinal-Epidural (CSE) Anesthesia.

Literature findings: RCTs report higher Apgar scores at 1 and 5 min for epidural anesthesia when compared with general anesthesia *(Category A2-B evidence).*[131-135] and equivocal findings for umbilical artery pH values *(Category A2-E evidence).*[133,135,136-137] When spinal anesthesia is compared with general anesthesia, RCTs report equivocal findings for 1 and 5 minute APGAR scores and umbilical artery pH values *(Category A1-E evidence).*[138-143] RCTs also are equivocal regarding total time in the operating room when epidural[144-148] or spinal[145,149] anesthesia is compared with general anesthesia *(Category A2-E evidence).*

When spinal anesthesia is compared with epidural anesthesia, RCTs are equivocal regarding induction-to-delivery times, hypotension, umbilical pH values and Apgar scores *(Category A2-E evidence).*[150-159]

When CSE is compared with epidural anesthesia, meta-analysis of RCTs found no differences in the frequency of hypotension or in 1-min Apgar scores *(Category A1-E evidence).*[160-166] RCTs report equivocal findings for delivery times, time in the operating room,

hypotension, and 1 and 5 minute APGAR scores when CSE is compared with spinal anesthesia *(Category A2-E evidence).*[167-171]

Survey findings: The consultants and ASA members strongly agree that (1) the decision to use a particular anesthetic technique for cesarean delivery should be individualized, based on anesthetic, obstetric or fetal risk factors (*e.g.*, elective *vs.* emergency), the preferences of the patient, and the judgment of the anesthesiologist; (2) uterine displacement (usually left displacement) should be maintained until delivery regardless of the anesthetic technique used; (3) consider selecting neuraxial techniques in preference to general anesthesia for most cesarean deliveries; (4) if spinal anesthesia is chosen, use pencil-point spinal needles instead of cutting-bevel spinal needles; (5) for urgent cesarean delivery, an indwelling epidural catheter may be used as an alternative to initiation of spinal anesthesia; and (6) general anesthesia may be the most appropriate choice in some circumstances (*e.g.*, profound fetal bradycardia, ruptured uterus, severe hemorrhage, severe placental abruption).

3. Intravenous Fluid Preloading or Coloading.

Literature findings: RCT findings are inconsistent regarding the frequency of maternal hypotension when intravenous fluid preloading or coloading for spinal anesthesia are compared to no fluids *(Category A2-E evidence).*[172-181] A meta-analysis of RCTs is equivocal for maternal hypotension when intravenous fluid preloading is compared with coloading *(Category A2-E evidence).*[182-187]

Survey findings: The consultants and ASA members agree that intravenous fluid preloading may be used to reduce the frequency of maternal hypotension following spinal anesthesia for cesarean delivery. The ASA members agree and the consultants strongly agree that although fluid preloading reduces the frequency of maternal hypotension, do not delay the initiation of spinal anesthesia in order to administer a fixed volume of intravenous fluid.

4. Ephedrine or phenylephrine.

Literature findings: Meta-analysis of double-blind placebo-controlled RCTs report reduced maternal hypotension during anesthesia for cesarean delivery when intravenous ephedrine is administered *(Category A1-B evidence)*.[188-192] RCTs are equivocal for hypotension when intramuscular ephedrine is compared with placebo *(Category A2-E evidence)*.[193-195] RCTs comparing phenylephrine with placebo report a lower frequency of hypotension when higher dosages of phenylephrine are administered *(Category A2-B evidence) and equivocal findings when lower dosages are administered (Category A2-E evidence)*.[193,196-198] Meta-analysis of double-blind RCTs report lower frequencies of patients with hypotension when infusions of phenylephrine are compared with ephedrine *(Category A1-B evidence)*;[199-204] higher umbilical artery pH values are reported for phenylephrine when compared with ephedrine *(Category A1-H evidence)*.[205-210]

Survey findings: The consultants and ASA members strongly agree that intravenous ephedrine and phenylephrine both may be used for treating hypotension during neuraxial anesthesia.

5. Neuraxial Opioids for Postoperative Analgesia.

Literature findings: RCTs comparing epidural opioids with intermittent injections of intravenous or intramuscular opioids report improved postoperative analgesia for epidural opioids after cesarean delivery *(Category A2-B evidence)*;[211-217] meta-analysis of RCTs report equivocal findings for nausea, vomiting, and pruritus *(Category A1-E evidence)*.[211-215,217-223] RCTs report improved postoperative analgesia when PCEA is compared with intravenous PCA *(Category A2-B evidence)* with equivocal findings for nausea, vomiting, pruritus, and sedation *(Category A2-E evidence)*.[219,222]

Survey findings: The consultants and ASA members strongly agree that for postoperative analgesia after neuraxial anesthesia for cesarean delivery, consider selecting neuraxial opioids rather than intermittent injections of parenteral opioids.

Recommendations for anesthetic care for cesarean delivery.

Equipment, Facilities, and Support Personnel:

- Equipment, facilities, and support personnel available in the labor and delivery operating suite should be comparable to those available in the main operating suite.
- Resources for the treatment of potential complications (*e.g.*, failed intubation, inadequate analgesia/anesthesia, hypotension, respiratory depression, local anesthetic systemic toxicity (LAST), pruritus, vomiting) should also be available in the labor and delivery operating suite.
- Appropriate equipment and personnel should be available to care for obstetric patients recovering from neuraxial or general anesthesia.

General, epidural, spinal, or CSE anesthesia:

- The decision to use a particular anesthetic technique for cesarean delivery should be individualized, based on anesthetic, obstetric or fetal risk factors (*e.g.*, elective *vs.* emergency), the preferences of the patient, and the judgment of the anesthesiologist.
    - Uterine displacement (usually left displacement) should be maintained until delivery regardless of the anesthetic technique used.
- Consider selecting neuraxial techniques in preference to general anesthesia for most cesarean deliveries.
- If spinal anesthesia is chosen, use pencil-point spinal needles instead of cutting-bevel spinal needles.
- For urgent cesarean delivery, an indwelling epidural catheter may be used as an alternative to initiation of spinal or general anesthesia.

- General anesthesia may be the most appropriate choice in some circumstances (*e.g.*, profound fetal bradycardia, ruptured uterus, severe hemorrhage, and severe placental abruption).

Intravenous Fluid Preloading or Coloading:

- Intravenous fluid preloading or coloading may be used to reduce the frequency of maternal hypotension following spinal anesthesia for cesarean delivery.
- Do not delay the initiation of spinal anesthesia in order to administer a fixed volume of intravenous fluid.

Ephedrine or phenylephrine:

- Either intravenous ephedrine or phenylephrine may be used for treating hypotension during neuraxial anesthesia.
- In the absence of maternal bradycardia, consider selecting phenylephrine because of improved fetal acid-base status in uncomplicated pregnancies.

Neuraxial Opioids for Postoperative Analgesia:

- For postoperative analgesia after neuraxial anesthesia for cesarean delivery, consider selecting neuraxial opioids rather than intermittent injections of parenteral opioids.

Postpartum Tubal Ligation

Literature findings: There is insufficient literature to evaluate the benefits of neuraxial anesthesia compared to general anesthesia for postpartum tubal ligation. In addition, the literature is insufficient to evaluate the impact of the timing of a postpartum tubal ligation on maternal outcome.

Survey findings: The consultants and ASA members strongly agree (1) that before postpartum tubal ligation, the patient should have no oral intake of solid foods within 6 - 8 h of the surgery, depending on the type of food ingested (*e.g.*, fat content), and (2) that both the timing of the procedure and the decision to use a particular anesthetic technique (*i.e.*, neuraxial

608 *vs.* general) should be individualized based on anesthetic risk factors, obstetric risk factors (*e.g.*,
609 blood loss), and patient preferences. The ASA members agree and the consultants strongly agree
610 to consider selecting neuraxial techniques in preference to general anesthesia for most
611 postpartum tubal ligations.

612 ***Recommendations for postpartum tubal ligation.***

613 • Before a postpartum tubal ligation, the patient should have no oral intake of solid
614 foods within 6 - 8 h of the surgery, depending on the type of food ingested (*e.g.*, fat
615 content).[§§§]

616 • Consider aspiration prophylaxis.

617 • Both the timing of the procedure and the decision to use a particular anesthetic
618 technique (*i.e.*, neuraxial *vs.* general) should be individualized, based on anesthetic
619 and obstetric risk factors (*e.g.*, blood loss), and patient preferences.

620 • Consider selecting neuraxial techniques in preference to general anesthesia for most
621 postpartum tubal ligations.

622 o Be aware that gastric emptying will be delayed in patients who have received
623 opioids during labor.

624 o Be aware that an epidural catheter placed for labor may be more likely to fail
625 with longer post-delivery time intervals.

626 o If a postpartum tubal ligation is to be performed before the patient is
627 discharged from the hospital, do not attempt the procedure at a time when it

[§§§] Practice guidelines for preoperative fasting and the use of pharmacologic agents to reduce the risk of pulmonary aspiration: an Updated Report by the American Society of Anesthesiologists Task Force on Preoperative Fasting. ANESTHESIOLOGY 2011; 114:495-511.

might compromise other aspects of patient care on the labor and delivery unit.[****]

Management of Obstetric and Anesthetic Emergencies

Management of obstetric and anesthetic emergencies consists of (1) resources for management of hemorrhagic emergencies, (2) equipment for management of airway emergencies, and (3) cardiopulmonary resuscitation.

1. Resources for Management of Hemorrhagic Emergencies.

Studies with observational findings and case reports suggest that the availability of resources for hemorrhagic emergencies may be associated with reduced maternal complications *(Category B3/B4-B evidence).*[224-231]

Survey findings: The consultants and ASA members strongly agree that institutions providing obstetric care should have resources available to manage hemorrhagic emergencies.

2. Equipment for Management of Airway Emergencies.

Case reports suggest that the availability of equipment for the management of airway emergencies may be associated with reduced maternal, fetal and neonatal complications *(Category B4-B evidence).*[232-241]

Survey findings: The consultants and ASA members strongly agree that labor and delivery units should have personnel and equipment readily available to manage airway emergencies consistent with the ASA Practice Guidelines for Management of the Difficult Airway, to include a pulse oximeter and carbon dioxide detector.

3. Cardiopulmonary Resuscitation.

Literature findings: The literature is insufficient to evaluate the efficacy of cardiopulmonary resuscitation in the obstetric patient during labor and delivery. In cases of cardiac arrest, the

[****] The American College of Obstetricians and Gynecologists (ACOG) has indicated that postpartum tubal ligation "should be considered an urgent surgical procedure given the consequences of a missed procedure and the limited time frame in which it may be performed." ACOG Committee Opinion No. 530: Access to postpartum sterilization. Obstet Gynecol 2012; 120: 212-215.

American Heart Association has stated that 4 - 5 min is the maximum time rescuers will have to determine if the arrest can be reversed by Basic Life Support and Advanced Cardiac Life Support interventions.[††††] Delivery of the fetus may improve cardiopulmonary resuscitation of the mother by relieving aortocaval compression. The American Heart Association further notes that "the best survival rate for infants >24 to 25 weeks in gestation occurs when the delivery of the infant occurs no more than 5 min after the mother's heart stops beating.

Survey findings: The consultants and ASA members strongly agree that (1) basic and advanced life-support equipment should be immediately available in the operative area of labor and delivery units and (2) if cardiac arrest occurs during labor and delivery, initiate standard resuscitative measures with accommodations for pregnancy such as left uterine displacement and preparing for delivery of the fetus.

Recommendations for management of obstetric and anesthetic emergencies.

Resources for Management of Hemorrhagic Emergencies:

- Institutions providing obstetric care should have resources available to manage hemorrhagic emergencies (table 1).
    - In an emergency, type-specific or O negative blood is acceptable.
    - In cases of intractable hemorrhage when banked blood is not available or the patient refuses banked blood, consider intraoperative cell-salvage if available.[‡‡‡‡]

Equipment for Management of Airway Emergencies:

- Labor and delivery units should have personnel and equipment readily available to manage airway emergencies consistent with the ASA Practice Guidelines for

[††††] 2010 American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. Circulation 2010; 122 (18 suppl 3):S640-933.

[‡‡‡‡] Practice Guidelines for Perioperative Blood Management: an Updated Report by the American Society of Anesthesiologists Task Force on Perioperative Blood Management. ANESTHESIOLOGY 2015; 122:241-275.

673 Management of the Difficult Airway,[§§§§] to include a pulse oximeter and carbon
674 dioxide detector.
675 - Basic airway management equipment should be immediately available during
676 the provision of neuraxial analgesia (table 2).
677 - Portable equipment for difficult airway management should be readily
678 available in the operative area of labor and delivery units (table 3).
679 - A preformulated strategy for intubation of the difficult airway should be in
680 place.
681 - When tracheal intubation has failed, consider ventilation with mask and
682 cricoid pressure, or with a supraglottic airway device (*e.g.*, laryngeal mask
683 airway, intubating laryngeal mask airway, laryngeal tube) for maintaining an
684 airway and ventilating the lungs.
685 - If it is not possible to ventilate or awaken the patient, create an airway
686 surgically.

687 *Cardiopulmonary Resuscitation:*

688 • Basic and advanced life-support equipment should be immediately available in the
689 operative area of labor and delivery units.
690 • If cardiac arrest occurs, initiate standard resuscitative measures.
691 - Uterine displacement (usually left displacement) should be maintained.
692 - If maternal circulation is not restored within 4 min, cesarean delivery should
693 be performed by the obstetrics team.[*****]

[§§§§] American Society of Anesthesiologists Task Force on Management of the Difficult Airway: Practice guidelines for management of the difficult airway: An Updated Report. ANESTHESIOLOGY 2013; 118:251-270.

[*****] More information on management of cardiac arrest can be found in: Lipman S, Cohen S, Einav S, Jeejeebhoy F, Mhyre JM, Morrison LJ, Katz V, Tsen LC, Daniels K, Halamek LP, Suresh MS, Arafeh J, Gauthier D, Carvalho JC, Druzin M, Carvalho B; Society for Obstetric Anesthesia and Perinatology: The Society for Obstetric Anesthesia and Perinatology consensus statement on the management of cardiac arrest in pregnancy. Anesth Analg. 2014 May; 118(5):1003.

References:

1. Aya AG, Vialles N, Tanoubi I, Mangin R, Ferrer JM, Robert C, Ripart J, de La Coussaye JE: Spinal anesthesia-induced hypotension: a risk comparison between patients with severe preeclampsia and healthy women undergoing preterm cesarean delivery. Anesth Analg 2005; 101:869-875
2. Bateman BT, Bansil P, Hernandez-Diaz S, Mhyre JM, Callaghan WM, Kuklina EV: Prevalence, trends, and outcomes of chronic hypertension: a nationwide sample of delivery admissions. Am J Obstet Gynecol. 2012; 206(2):134.e1-8
3. Crosby ET: Obstetrical anaesthesia for patients with the syndrome of haemolysis, elevated liver enzymes and low platelets. Can J Anaesth 1991; 38:227-233
4. Goodall PT, Ahn JT, Chapa JB, Hibbard JU: Obesity as a risk factor for failed trial of labor in patients with previous cesarean delivery. Am J Obstet Gynecol 2005; 192:1423-1426
5. Grotegut CA1, Kuklina EV, Anstrom KJ, Heine RP, Callaghan WM, Myers ER, James AH: Factors associated with the change in prevalence of cardiomyopathy at delivery in the period 2000-2009: a population-based prevalence study. BJOG 2014; 121:1386-1394
6. Leffert LR1, Clancy CR, Bateman BT, Bryant AS, Kuklina EV: Hypertensive disorders and pregnancy-related stroke: frequency, trends, risk factors, and outcomes. Obstet Gynecol 2015; 125:124-131
7. Mhyre JM, Bateman BT, Leffert LR: Influence of patient comorbidities on the risk of near-miss maternal morbidity or mortality. Anesthesiology 2011; 115:963-972
8. Naef RW III, Chauhan SP, Chevalier SP, Roberts WE, Meydrech EF, Morrison JC: Prediction of hemorrhage at cesarean delivery. Obstet Gynecol 1994; 83:923-926
9. Robinson HE, O'Connell CM, Joseph KS, McLeod NL: Maternal outcomes in pregnancies complicated by obesity. Obstet Gynecol 2005; 106:1357-1364
10. Suelto MD, Vincent RD Jr, Larmon JE, Norman PF, Werhan CF: Spinal anesthesia for postpartum tubal ligation after pregnancy complicated by preeclampsia or gestational hypertension. Reg Anesth Pain Med 2000; 25:170-173
11. von Ungern-Sternberg BS, Regli A, Bucher E, Reber A, Schneider MC: Impact of spinal anaesthesia and obesity on maternal respiratory function during elective Caesarean section. Anaesthesia 2004; 59:743-749
12. Weiner MM, Vahl TP, Kahn RA: Case scenario: Cesarean section complicated by rheumatic mitral stenosis. Anesthesiology 2011; 114:949-957
13. Simon L, Santi TM, Sacquin P, Hamza J: Pre-anaesthetic assessment of coagulation abnormalities in obstetric patients: usefulness, timing and clinical implications. Br J Anaesth 1997; 78:678-683
14. de Vries JI, Vellenga E, Aarnoudse JG: Plasma beta-thromboglobulin in normal pregnancy and pregnancy-induced hypertension. Eur J Obstet Gynecol Reprod Biol 1983; 14:209-216
15. Druzin ML, Stier E: Maternal platelet count at delivery in patients with idiopathic thrombocytopenic purpura, not related to perioperative complications. J Am Coll Surg 1994; 179:264-266
16. FitzGerald MP, Floro C, Siegel J, Hernandez E: Laboratory findings in hypertensive disorders of pregnancy. J Natl Med Assoc 1996; 88:794-798
17. Hepner DL, Tsen LC: Severe thrombocytopenia, type 2B von Willebrand disease and pregnancy. Anesthesiology 2004; 101:1465-1467
18. Leduc L, Wheeler JM, Kirshon B, Mitchell P, Cotton DB: Coagulation profile in severe preeclampsia. Obstet Gynecol 1992; 79:14-18

19. Ramanathan J, Sibai BM, Vu T, Chauhan D: Correlation between bleeding times and platelet counts in women with preeclampsia undergoing cesarean section. Anesthesiology 1989; 71:188-191
20. Roberts WE, Perry KG, Jr., Woods JB, Files JC, Blake PG, Martin JN, Jr.: The intrapartum platelet count in patients with HELLP (hemolysis, elevated liver enzymes, and low platelets) syndrome: is it predictive of later hemorrhagic complications? Am J Obstet Gynecol 1994; 171:799-804
21. Romero R, Mazor M, Lockwood CJ, Emamian M, Belanger KP, Hobbins JC, Duffy T: Clinical significance, prevalence, and natural history of thrombocytopenia in pregnancy-induced hypertension. Am J Perinatol 1989; 6:32-38
22. Abboud TK, Khoo SS, Miller F, Doan T, Henriksen EH: Maternal, fetal, and neonatal responses after epidural anesthesia with bupivacaine, 2-chloroprocaine, or lidocaine. Anesth Analg 1982; 61:638-644
23. Abouleish E: Foetal bradycardia during caudal analgesia: A discussion of possible causative factors. Br J Anaesth 1976; 48:481-48
24. Boehm FH, Woodruff LF, Jr., Growdon JH, Jr: The effect of lumbar epidural anesthesia on fetal heart rate baseline variability. Anesth Analg 1975; 54:779-782
25. Jouppila P, Jouppila R, Kaar K, Merila M: Fetal heart rate patterns and uterine activity after segmental epidural analgesia. Br J Obstet Gynaecol 1977; 84:481-486
26. Spencer JA, Koutsoukis M, Lee A: Fetal heart rate and neonatal condition related to epidural analgesia in women reaching the second stage of labour. Eur J Obstet Gynecol Reprod Biol 1991; 41:173-178
27. Swayze CR, Skerman JH, Walker EB, Sholte FG: Efficacy of subarachnoid meperidine for labor analgesia. Reg Anesth 1991; 16:309-313
28. Stavrou C, Hofmeyr GJ, Boezaart AP: Prolonged fetal bradycardia during epidural analgesia. Incidence, timing and significance. S Afr Med J 1990; 77:66-68
29. Zilianti M, Salazar JR, Aller J, Aguero O: Fetal heart rate and pH of fetal capillary blood during epidural analgesia in labor. Obstet Gynecol 1970; 36(6):881-886
30. Dewan DM, Floyd HM, Thistlewood JM, Bogard TD, Spielman FJ: Sodium citrate pretreatment in elective cesarean section patients. Anesth Analg 1985; 64:34-37
31. Jasson J, Lefevre G, Tallet F, Talafre ML, Legagneux F, Conseiller C: Oral sodium citrate before general anesthesia for elective cesarean section. Effects on pH and volume of gastric content. Ann Fr Anesth Reanim 1989; 8:12-18
32. Ormezzano X, Francois TP, Viaud JY, Bukowski JG, Bourgeonneau MC, Cottron D, Ganansia MF, Gregoire FM, Grinand MR, Wessel PE: Aspiration pneumonitis prophylaxis in obstetric anaesthesia: comparison of effervescent cimetidine-sodium citrate mixture and sodium citrate. Br J Anaesth 1990; 64:503-506
33. Wig J, Biswas GC, Malhotra SK, Gupta AN: Comparison of sodium citrate with magnesium trisilicate as pre-anaesthetic antacid in emergency caesarean sections. Indian J Med Res 1987; 85:306-310
34. Lin CJ, Huang CL, Hsu HW, Chen TL: Prophylaxis against acid aspiration in regional anesthesia for elective cesarean section: a comparison between oral single-dose ranitidine, famotidine and omeprazole assessed with fiberoptic gastric aspiration. Acta Anaesthesiol Sin 1996; 34:179-184
35. O'Sullivan GM, Sear JW, Bullingham RES, Carrie LES: The effect of magnesium trisilicate mixture, metoclopramide and ranitidine on gastric pH, volume and serum gastrin. Anaesthesia 1985; 40;246-253
36. Qvist N, Storm K: Cimethidine pre-anesthetic. A prophylactic method against Mendelson's syndrome in cesarean section. Acta Obstet Gynecol Scand 1983; 62:157-159

37. Cooke RD, Comyn DJ, Ball RW: Prevention of postoperative nausea and vomiting by domperidone: A double-blind randomized study using domperidone, metoclopramide and a placebo. S Afr Med J 1979; 56:827-829
38. Danzer BI, Birnbach DJ, Stein DJ, Kuroda MM, Thys DM: Does metoclopramide supplement postoperative analgesia using patient-controlled analgesia with morphine in patients undergoing elective cesarean delivery? Reg Anesth 1997; 22:424-427
39. Lussos SA, Bader AM, Thornhill ML, Datta S: The antiemetic efficacy and safety of prophylactic metoclopramide for elective cesarean delivery during spinal anesthesia. Reg Anesth 1992; 17:126-130
40. Pan PH, Moore CH: Comparing the efficacy of prophylactic metoclopramide, ondansetron, and placebo in cesarean section patients given epidural anesthesia. J Clin Anesth 2001; 13:430-435
41. Stein DJ, Birnbach DJ, Danzer BI, Kuroda MM, Grunebaum A, Thys DM: Acupressure versus intravenous metoclopramide to prevent nausea and vomiting during spinal anesthesia for cesarean section. Anesth Analg 1997; 84:342-345
42. Chestnut DH, McGrath JM, Vincent RD, Jr., Penning DH, Choi WW, Bates JN, McFarlane C: Does early administration of epidural analgesia affect obstetric outcome in nulliparous women who are in spontaneous labor? Anesthesiology 1994; 80:1201-1208
43. Chestnut DH, Vincent Jr RD, McGrath JM, Choi WW, Bates JN: Does early administration of epidural analgesia affect obstetric outcome in nulliparous women who are receiving intravenous oxytocin? Anesthesiology 1994; 80:1193-2000
44. Luxman E, Wolman I, Groutz A, Cohen JR, Lottan M, Pauzner D, David MP: The effect of early epidural block administration on the progression and outcome of labor. Int J Obstet Anesth 1998; 7:161-164
45. Ohel G, Gonen R, Vaida S, Barak S, Gaitini L: Early versus late initiation of epidural analgesia in labor: Does it increase the risk of cesarean section? A randomized trial. Am J Obstet Gynecol 2006; 194:600-605
46. Wang F, Shen X, Guo X, Peng Y, Gu X, The Labor Analgesia Examining Group: Epidural analgesia in the latent phase of labor and the risk of cesarean delivery. Anesthesiology 2009; 111:871-880Matouskova A, Hanson B, Elm'en H: Continuous mini-infusion of bupivacaine into the epidural space during labor. Part III: A clinical study of 225 patients. Acta Obstet Gynecol Scand Suppl 1979; 83:43-52
47. Parameswara G, Kshama K, Murthy HK, Jalaja K, Venkat S: Early epidural labour analgesia: Does it increase the chances of operative delivery? Br J Anaesth 2012; 108 (Suppl 2):ii213-ii214
48. Wang LZ, Chang XY, Hu XX, Tang BL, Xia F: The effect on maternal temperature of delaying initiation of the epidural component of combined spinal-epidural analgesia for labor: A pilot study. Ing J Obstet Anesth 2011; 20:312-317
49. Wong CA, McCarthy RJ, Sullivan JT, Scavone BM, Gerber SE, Yaghmour EA: Early compared with late neuraxial analgesia in nulliparous labor induction: a randomized controlled trial. Obstet Gynecol 2009; 113:1066-1074
50. Carlsson C, Nybell-Lindahl G, Ingemarsson I: Extradural block in patients who have perviously undergone caesarean section. Br J Anaesth 1980; 52:827-830
51. Flamm BL, Lim OW, Jones C, Fallon D, Newman LA, Mantis JK: Vaginal birth after cesarean section: results of a multicenter study. Am J Obstet Gynecol 1988; 158:1079-1084
52. Meehan FP, Burke G, Kehoe JT: Update on delivery following prior cesarea section: a fifteen year review 1972-1987. Int J Gynecol Obstet 1989; 30:205-212
53. Sakala EP, Kaye S, Murray RD, Munson LJ: Epidural analgesia: effect on the liklihood of a successful trial of labor after cesarean section. J Reprod Med 1990; 35:886-890

54. Stovall TG, Shaver DC, Solomon SK, Anderson GD: Trial of labor in previous cesarean section patients, excluding classical cesarean sections. Obstet Gynecol 1987; 70:713-717
55. Bofill JA, Vincent RD, Road EI, Martin RW, Norman PF, Werham CF, Morrison JC: Nulliparous active labor, epidural analgesia, and cesarean delivery for dystocia. Am J Obstet Gyn 1997; 177:1465-1470
56. Ramin SM, Gambling DR, Lucas MJ, Sharma SK, Sidawi JE, Leveno KJ: Randomized trial of epidural versus intravenous analgesia during labor. Obstet Gynecol 1995; 86:783-789
57. Loughnan BA, Carli F, Romney M, Doré CJ, Gordon H. Randomized controlled comparison of epidural bupivacaine versus pethidine for analgesia in labour. Br J Anaesth 2000; 84:715-719
58. Nielsen PE, Erickson JR, Abouleish EI, Perriatt S, Sheppard C: Fetal heart rate changes after intrathecal sufentanil or epidural bupivacaine for labor analgesia: incidence and clinical significance. Anesth Analg 1996; 83:742-746
59. Desprats R, Mandry J, Grandjean H, Amar B, Pontonnier G, Lareng L: Peridural analgesia during labor: comparative study of a fentanyl-marcaine combination and marcaine alone. J Gynecol Obstet Biol Reprod Paris 1983; 12:901-905
60. Niv D, Rudick V, Golan A, Chayen MS: Augmentation of bupivacaine analgesia in labor by epidural morphine. Obstet Gynecol 1986; 67:206-209
61. Phillips GH: Epidural sufentanil/bupivacaine combinations for analgesia during labor: effect of varying sufentanil doses. Anesthesiology 1987; 67:835-838
62. Vertommen JD, Vandermeulen E, Van Aken H, Vaes L, Soetens M, Van Steenberge A, Mourisse P, Willaert J, Noorduin H, Devlieger H, Van Assche AF: The effects of the addition of sufentanil to 0.125% bupivacaine on the quality of analgesia during labor and on the incidence of instrumental deliveries. Anesthesiology 1991; 74:809-814
63. Yau G, Gregory MA, Gin T, Oh TE: Obstetric epidural analgesia with mixtures of bupivacaine, adrenaline and fentanyl. Anaesthesia 1990; 45:1020-1023
64. Abboud TK, Afrasiabi A, Zhu J, Mantilla M, Reyes A, D'Onofrio L, Khoo N, Mosaad P, Richardson M, Kalra M, Cheung M, Paul R: Epidural morphine or butorphanol augments bupivacaine analgesia during labor. Reg Anesth 1989; 14:115-120
65. Abboud TK, Zhu J, Afrasiabi A, Reyes A, Sherman G, Khan R, Vera Cruz R, Steffens Z: Epidural butorphanol augments lidocaine sensory anesthesia during labor. Reg Anesth 1991; 16:265-267
66. Edwards ND, Hartley M, Clyburn P, Harmer M: Epidural pethidine and bupivacaine in labour. Anaesthesia 1992; 47:435-437
67. Lehmann KA, Stern S, Breuker KH: Obstetrical peridural anesthesia with bupivacaine and buprenorphine. A randomized double-blind study in comparison with untreated controls. Anaesthesist 1992; 41:414-422
68. Lirzin JD, Jacquinot P, Dailland P, Jorrot JC, Jasson J, Talafre ML, Conseiller C: Controlled trial of extradural bupivacaine with fentanyl, morphine or placebo for pain relief in labour. Br J Anaesth 1989; 62:641-644
69. Milon D, Lavenac G, Noury D, Allain H, Van den Driessche J, Saint Marc C: Epidural anesthesia during labor: comparison of 3 combinations of fentanyl-bupivacaine and bupivacaine alone. Ann Fr Anesth Reanim 1986; 5:18-23
70. Sinatra RS, Goldstein R, Sevarino FB: The clinical effectiveness of epidural bupivacaine, bupivacaine with lidocaine, and bupivacaine with fentanyl for labor analgesia. J Clin Anesth 1991; 3:219-224
71. Viscomi CM, Hood DD, Melone PJ, Eisenach JC: Fetal heart rate variability after epidural fentanyl during labor. Anesth Analg 1990; 71:679-683
72. Yau G, Gregory MA, Gin T, Bogod DG, Oh TE: The addition of fentanyl to epidural bupivacaine in first stage labour. Anaesth Intensive Care 1990; 18:532-535

73. Chestnut DH, Owen CL, Bates JN, Ostman LG, Choi WW, Geiger MW: Continuous infusion epidural analgesia during labor: a randomized, double-blind comparison of 0.0625% bupivacaine/0.0002% fentanyl versus 0.125% bupivacaine. Anesthesiology 1988; 68:754-759
74. Elliott RD: Continuous infusion epidural analgesia for obstetrics: bupivacaine versus bupivacaine-fentanyl mixture. Can J Anaesth 1991; 38:303-310
75. Lee BB, Ngan Kee WD, Ng FF, Lau TK, Wong EL: Epidural infusions for labor analgesia: a comparison of 0.2% ropivacaine, 0.1% ropivacaine, and 0.1% ropivacaine with fentanyl. Reg Anesth Pain Med 2002; 27:31-36
76. Porter JS, Bonello E, Reynolds F: The effect of epidural opioids on maternal oxygenation during labour and delivery. Anaesthesia 1996; 51:899-903
77. Rodriguez J, Abboud TK, Reyes A, Payne M, Zhu J, Steffens Z, Afrasiabi A: Continuous infusion epidural anesthesia during labor: a randomized, double-blind comparison of 0.0625% bupivacaine/0.002% butorphanol and 0.125% bupivacaine. Reg Anesth 1990; 15:300-303
78. Russell R, Reynolds F: Epidural infusion of low-dose bupivacaine and opioid in labour. Does reducing motor block increase the spontaneous delivery rate? Anaesthesia 1996; 51:266-273
79. Reynolds F, Russell R, Porter J, Smeeton M: Does the use of low dose bupivacaine/opioid epidural infusion increase the normal delivery rate? Int J Obstet Anesth 2003; 12:156-163
80. Camann WR, Denney RA, Holby ED, Datta S: A comparison of intrathecal, epidural, and intravenous sufentanil for labor analgesia. Anesthesiology 1992; 77:884-887
81. Edwards RD, Hansel NK, Pruessner HT, Barton B: Intrathecal morphine sulfate for labor pain. Tex Med 1985; 81:46-48
82. Edwards RD, Hansel NK, Pruessner HT, Barton B: Intrathecal morphine as analgesia for labor pain. J Am Board Fam Pract 1988; 1:245-250
83. Herpolsheimer A, Schretenthaler J: The use of intrapartum intrathecal narcotic analgesia in a community-based hospital. Obstet Gynecol 1994; 84:931-936
84. Cesarini M, Torrielli R, Lahaye F, Mene JM, Cabiro C: Sprotte needle for intrathecal anaesthesia for caesarean section: incidence of postdural puncture headache. Anaesthesia 1990; 45:656-658
85. Devcic A, Sprung J, Patel S, Kettler R, Maitra DA: PDPH in obstetric anesthesia: comparison of 24-gauge Sprotte and 25-gauge Quincke needles and effect of subarachnoid administration of fentanyl. Reg Anesth 1993; 18:222-225
86. Mayer DC, Quance D, Weeks SK: Headache after spinal anesthesia for cesarean section: a comparison of the 27-gauge Quincke and 24-gauge Sprotte needles. Anesth Analg 1992; 75:377-380
87. Shutt LE, Valentine SJ, Wee MYK, Page RJ, Prossner A, Thomas TA: Spinal anaesthesia for caesarean section: comparison of 22 gauge and 25 gauge Whitacre needles with 26 gauge Quincke needles. Br J Anaesth 1992; 69:589-594
88. Vallejo MC, Mandell GL, Sabo DP, Ramanathan S: Postdural puncture headache: a randomized comparison of five spinal needles in obstetric patients. Anesth Analg 2000; 91:916-920
89. Hepner DL, Gaiser RR, Cheek TG, Gutsche BB: Comparison of combined spinal-epidural and low dose epidural for labour analgesia. Can J Anaesth 2000; 47:232-236
90. Kartawiadi L, Vercauteren MP, van Steenberge AL, Adriaensen HA: Spinal analgesia during labor with low-dose bupivacaine, sufentanil, and epinephrine. A comparison with epidural analgesia. Reg Anesth 1996; 21:191-196
91. Nickells JS, Vaughan DJ, Lillywhite NK, Loughnan B, Hasan M, Robinson PN: Speed of onset of regional analgesia in labour: a comparison of the epidural and spinal routes. Anaesthesia 2000; 55:17-20
92. Patel NP, El-Wahab N, Fernando R, Wilson S, Robson SC, Columb MO, Lyons GR: Fetal effects of combined spinal-epidural vs epidural labour analgesia: a prospective, randomised double-blind study. Anaesthesia 2014; 69:458-467
93. Roux M, Wattrisse G, Tai RB, Dufossez F, Krivosic-Horber R: Obstetric analgesia: peridural analgesia versus combined spinal and peridural analgesia. Ann Fr Anesth Reanim 1999; 18:487-498

94. Sezer O, Gunaydin B: Efficacy of patient-controlled epidural analgesia after initiation with epidural or combined spinal-epidural analgesia. Int J Obstet Anesth 2007; 16:226-230
95. Vernis L, Duale C, Storme B, Mission JP, Rol B, Schoeffler P: Perispinal analgesia for labour followed by patient-controlled infusion with bupivacaine and sufentanil: combined spinal-epidural vs. epidural analgesia alone. Eur J Anaesthesiol 2004; 21:186-192
96. Cooper G, MacArthur C, Wilson M, Moore P, Shennan A (COMET Study Group): Satisfaction, control and pain relief: short-and long-term assessments in a randomised controlled trial of low-dose and traditional epidurals and a non-epidural comparison group. Int J Obstet Anesth 2010; 19:31-37
97. Cortes CAF, Sanchez CA, Oliveira AS, Sanchez FM: Labor Analgesia: a comparative study between combined spinal-epidural anesthesia versus continuous epidural anesthesia. Rev Bras Anestesiol 2007; 57:39-51
98. Gambling D, Berkowitz J, Farrell T, Pue A, Shay D: A randomized controlled comparison of epidural analgesia and combined spinal-epidural analgesia in a private practice setting: pain scores druing first and second stages of labor and delivery. Anesth Anal 2013; 116:636-643
99. Pascual-Ramirez J, Haya J, Perez-Lopez F, Gil-Trujillo S, Garrido-Esteban R, Berna G: Effect of combined spinal-epidural analgesia versus epidural analgesia on labor and delivery duration. Int J Gynaecol Obstet 2011; 114:246-250
100. Price C, Lafreniere L, Brosnan C, Findlay I: Regional analgesia in early active labour: combined spinal-epidural vs epidural. Anaesthesia 1998; 53:951-955
101. Curry PD, Pacsoo C, Heap DG: Patient-controlled epidural analgesia in obstetric anaesthetic practice. Pain 1994; 57:125-127
102. Ferrante FM, Barber MJ, Segal M, Hughes NJ, Datta S: 0.0625% bupivacaine with 0.0002% fentanyl via patient-controlled epidural analgesia for pain of labor and delivery. Clin J Pain 1995; 11:121-126
103. Ferrante FM, Lu L, Jamison SB, Datta S: Patient-controlled epidural analgesia: demand dosing. Anesth Analg 1991; 73:547-552
104. Gambling DR, Huber CJ, Berkowitz J, Howell P, Swenerton JE, Ross PL, Crochetiere CT, Pavy TJ: Patient-controlled epidural analgesia in labour: varying bolus dose and lockout interval. Can J Anaesth 1993; 40:211-217
105. Haydon ML, Larson D, Reed E, Shrivastava V, Preslicka C, Nageotte M: Obstetric outcomes and maternal satisfaction in nulliparous women using patient-controlled epidural analgesia. Am J Obstet Gynecol 2011; 205:271.e1-6
106. Ledin Eriksson S, Gentele C, Olofsson CH: PCEA compared to continuous epidural infusion in an ultra-low-dose regimen for labor pain relief: a randomized study. Acta Anaesthesiol Scand 2003; 47:1085-1090
107. Boutros A, Blary S, Bronchard R, Bonnet F: Comparison of intermittent epidural bolus, continuous epidural infusion and patient controlled-epidural analgesia during labor. Int J Obstet Anesth 1999; 8:236-241
108. Collis RE, Plaat FS, Morgan BM: Comparison of midwife top-ups, continuous infusion and patient-controlled epidural analgesia for maintaining mobility after a low-dose combined spinal-epidural. Br J Anaesth 1999; 82:233-236
109. Ferrante FM, Lu L, Jamison SB, Datta S: Patient-controlled epidural analgesia: demand dosing. Anesth Analg 1991; 73:547-552
110. Ferrante FM, Rosinia FA, Gordon C, Datta S: The role of continuous background infusions in patient-controlled epidural analgesia for labor and delivery. Anesth Analg 1994; 79:80-84
111. Lysak SZ, Eisenach JC, Dobson CE II: Patient-controlled epidural analgesia during labor: a comparison of three solutions with a continuous infusion control. Anesthesiology 1990; 72:44-49
112. Saito M, Okutomi T, Kanai Y, Mochizuki J, Tani A, Amano K, Hoka S: Patient-controlled epidural analgesia during labor using ropivacaine and fentanyl provides better maternal satisfaction with less local anesthetic requirement. J Anesth 2005; 19:208-212

113. Sia AT, Chong JL: Epidural 0.2% ropivacaine for labour analgesia: parturient-controlled or continuous infusion? Anaesth Intensive Care 1999; 27:154-158
114. Smedvig JP, Soreide E, Gjessing L: Ropivacaine 1 mg/ml, plus fentanyl 2 microg/ml for epidural analgesia during labour. Is mode of administration important? Acta Anaesth Scand 2001; 45:595-599
115. Tan S, Reid J, Thorburn J: Extradural analgesia in labour: complications of three techniques of administration. Br J Anaesth 1994; 73:619-623
116. Vallejo M, Ramesh V, Phelps A, Sah N: Patient-controlled epidural analgesia with background infusion versus without a background infusion. J Pain 2007; 8:970-975
117. Bremerich DH, Waibel HJ, Mierdl S, Meininger D, Byhahn C, Zwissler BC, Ackermann HH: Comparison of continuous background infusion plus demand dose and demand-only parturient-controlled epidural analgesia (PCEA) using ropivacaine combined with sufentanil for labor and delivery. Int J Obstet Anesth 2005; 14:114-120
118. Lim Y, Sia AT, Ocampo CE: Comparison of computer integrated patient controlled epidural analgesia vs. conventional patient controlled epidural analgesia for pain relief in labour. Anaesthesia 2006; 61:339-344
119. Missant C, Teunkenst A, Vandermeersch E, Van de Velde M: Patient-controlled epidural analgesia following combined spinal-epidural analgesia in labour: the effects of adding a continuous epidural infusion. Anaesth Intensive Care 2005; 33:452-456
120. Paech MJ: Patient-controlled epidural analgesia in labour--is a continuous infusion of benefit? Anaesth Intensive Care 1992; 20:15-20
121. Petry J, Vercauteren M, Van Mol I, Van Houwe P, Adriaensen HA: Epidural PCA with bupivacaine 0.125%, sufentanil 0.75 microgram and epinephrine 1/800.000 for labor analgesia: is a background infusion beneficial? Acta Anaesthesiol Belg 2000; 51:163-166
122. Boselli E, Debon R, Cimino Y, Rimmele T, Allaouchiche B, Chassard D: Background infusion is not beneficial during labor patient-controlled analgesia with 0.1% ropivacaine plus 0.5 microg/ml sufentanil. Anesthesiology 2004; 100: 968-72
123. Bullarbo M, Tjugum J, Ekerhovd E: Sublingual nitroglycerin for management of retained placenta. Int J Gynaecol Obstet 2005; 91:228-232
124. Bullarbo M, Bokstrom H, Lilja H, Almstrom E, Lassenius N, Hansson A, Ekerhovd E: Nitroglycerine for management of retained placenta: a multicenter study. Obstet Gynecol Int 2012; 2012:321207
125. Visalyaputra S, Prechapanich J, Suwanvichai S, Yimyam S, Permpolprasert L, Suksopee P: Intravenous nitroglycerin for controlled cord traction in the management of retained placenta. Int J Gynaecol Obstet 2011; 112:103-106
126. Axemo P, Fu X, Lindberg B, Ulmsten U, Wessen A: Intravenous nitroglycerin for rapid uterine relaxation. Acta Obstetricia et Gynecologica Scandinavica. 1998;77:50–53
127. Chan AS, Ananthanarayan C, Rolbin SH: Alternating nitroglycerin and syntocinon to facilitate uterine exploration and removal of an adherent placenta. Can J Anaesth 1995; 42:335-337
128. Chedraui PA, Insuasti DF: Intravenous nitroglycerin in the management of retained placenta. Gynecol Obstet Invest 2003; 56:61-64
129. Lowenwirt IP, Zauk RM, Handwerker SM: Safety of intravenous glyceryl trinitrate in management of retained placenta. Aust N Z J Obstet Gynaecol 1997; 37:20-24
130. Riley ET, Flanagan B, Cohen SE, Chitkara U: Intravenous nitroglycerin: a potent uterine relaxant for emergency obstetric procedures. Review of literature and report of three cases. Int J Obstet Anesth 1996; 5:264-268
131. Dick W, Traub E, Kraus H, Tollner U, Burghard R, Muck J: General anaesthesia versus epidural anaesthesia for primary caesarean section--a comparative study. Eur J Anaesthesiol 1992; 9:15-21

132. Kolatat T, Somboonnanonda A, Lertakyamanee J, Chinachot T, Tritrakarn T, Muangkasem J: Effects of general and regional anesthesia on the neonate (a prospective, randomized trial). J Med Assoc Thai 1999; 82:40-45
133. Petropoulos G, Siristatidis C, Salamalekis E, Creatsas G: Spinal and epidural versus general anesthesia for elective cesarean section at term: effect on the acid-base status of the mother and newborn. J Matern Fetal Neonatal Med 2003;13:260-266
134. Ryhanen P, Jouppila R, Lanning M, Jouppila P, Hollm'en A, Kouvalainen K: Natural killer cell activity after elective cesarean section under general and epidural anesthesia in healthy parturients and their newborns. Gynecol Obstet Invest 1985; 19:139-142
135. Wallace DH, Leveno KJ, Cunningham FG, Giesecke AH, Shearer VE, Sidawi JE: Randomized comparison of general and regional anesthesia for cesarean delivery in pregnancies complicated by severe preeclampsia. Obstet Gynecol 1995; 86:193-199
136. Hollm'en AI, Jouppila R, Koivisto M, Maatta L, Pihlajaniemi R, Puukka M, Rantakyla P: Neurologic activity of infants following anesthesia for cesarean section. Anesthesiology 1978; 48:350-356
137. Sener EB, Guldogus F, Karakaya D, Baris S, Kocamanoglu S, Tur A: Comparison of neonatal effects of epidural and general anesthesia for cesarean section. Gynecol Obstet Invest 2003; 55:41-45
138. Dyer RA, Els I, Farbas J, Torr GJ, Schoeman LK, James MF: Prospective randomized trial comparing general with spinal anesthesia for cesarean delivery in preeclamptic patients with a nonreassuring fetal heart tract. Anesthesiology 2003; 99:561-569
139. Kavak ZN, Basgul A, Ceyhan N: Short-term outcome of newborn infants: Spinal versus general anesthesia for elective cesarean section: a prospective randomized study. Eur J Obstet Reprod Biol 2001; 100:50-54
140. Kolatat T, Somboonnanonda A, Lertakyamanee J, Chinachot T, Tritrakarn T, Muangkasem J: Effects of general and regional anesthesia on the neonate (a prospective, randomized trial). J Med Assoc Thai 1999; 82:40-45
141. Mancuso A, De Vivo A, Giacobbe A, Priola V, Savasta M, Guzzo M, DeVivo D, Mancuso A: General versus spinal anaesthesia for elective caesarean sections: effects on neonatal short-term outcome. A prospective randomised study. J Matern Fetal Neonatal Med 2010; 23:1114-1118
142. Moslemi F, Rasooli S: Comparison of spinal versus general anesthesia for cesarean delivery in patients with severe preeclampsia. J Med Sci; 7:1044-1048
143. Shaban M, Ali N, Abd El-Razek A: Spinal versus general anesthesia in preeclamptic patients undergoing cesrean delivery. El-Minia Med Bull 2005; 16:328-343
144. Hong JY, Jee YS, Yoon HJ, Kim SM: Comparison of general and epidural anesthesia in elective cesarean section for placenta previa totalis: maternal hemodynamics, blood loss and neonatal outcome. Int J Obstet Anesth 2003; 12:12-16
145. Lertakyamanee J, Chinachoti T, Tritrakarn T, Muangkasem J, Somboonnanonda A, Kolatat T: Comparison of general and regional anesthesia for cesarean section: success rate, blood loss and satisfaction from a randomized trial. J Med Assoc Thai 1999; 82: 672-680
146. Mancuso A, De Vivo A, Giacobbe A, Priola V, Savasta M, Guzzo M, DeVivo D, Mancuso A: General versus spinal anaesthesia for elective caesarean sections: effects on neonatal short-term outcome. A prospective randomised study. J Matern Fetal Neonatal Med 2010; 23:1114-1118
147. Sener EB, Guldogus F, Karakaya D, Baris S, Kocamanoglu S, Tur A: Comparison of neonatal effects of epidural and general anesthesia for cesarean section. Gynecol Obstet Invest 2003; 55:41-45

148. Wallace DH, Leveno KJ, Cunningham FG, Giesecke AH, Shearer VE, Sidawi JE: Randomized comparison of general and regional anesthesia for cesarean delivery in pregnancies complicated by severe preeclampsia. Obstet Gynecol 1995; 86:193-199
149. Fabris L, Maretoc A: Effects of general anaesthesia versus spinal anaesthesia for caesarean section on postoperative analgesic consumption and postoperative pain. Period Biol 2009; 111:251-255
150. Helbo Hansen S, Bang U, Garcia RS, Olesen AS, Kjeldsen L: Subarachnoid versus epidural bupivacaine 0.5% for caesarean section. Acta Anaesthesiol Scand 1988; 32:473-476
151. Kolatat T, Somboonnanonda A, Lertakyamanee J, Chinachot T, Tritrakarn T, Muangkasem J: Effects of general and regional anesthesia on the neonate (a prospective, randomized trial). J Med Assoc Thai 1999; 82:40-45
152. Lertakyamanee J, Chinachoti T, Tritrakarn T, Muangkasem J, Somboonnanonda A, Kolatat T: Comparison of general and regional anesthesia for cesarean section: success rate, blood loss and satisfaction from a randomized trial. J Med Assoc Thai 1999; 82: 672-680
153. McGuinness GA, Merkow AJ, Kennedy RL, Erenberg A: Epidural anesthesia with bupivacaine for cesarean section: neonatal blood levels and neurobehavioral responses. Anesthesiology 1978; 49:270-273
154. Morgan PJ, Halpern S, Lam-McCulloch J: Comparison of maternal satisfaction between epidural and spinal anesthesia for elective cesarean section. Can J Anaesth 2000; 47:956-961
155. Olofsson C, Ekblom A, Skoldefors E, Waglund B, Irestedt L: Anesthetic quality during cesarean section following subarachnoid or epidural administration of bupivacaine with or without fentanyl. Acta Anaesthesiol Scand 1997; 41:332-338
156. Robson SC, Boys RJ, Rodeck C, Morgan B: Maternal and fetal haemodynamic effects of spinal and extradural anaesthesia for elective caesarean section. Br J Anaesth 1992; 68:54-59
157. Sarvela J, Halonen P, Soikkeli A, Korttila K: A double-blinded, randomized comparison of intrathecal and epidural morphine for elective cesarean delivery. Anesth Analg 2002; 95:436-440
158. Schewe J, Komusin A, Zinserling J, Nadstawek J, Hoeft A, Hering R: Effects of spinal anaesthesia versus epidural anaesthesia for caesarean section on postoperative analgesic consumption and postoperative pain. Eur J Anaesthesiol 2009; 26:52-59
159. Visalyaputra S, Rodanant O, Somboonviboon W, Tantivitayatan K, Thienthong S, Saengchote W: Spinal versus epidural anesthesia for cesarean delivery in severe preeclampsia: a prospective randomized, multicenter study. Anesth Analg 2005; 101:862-868
160. Berends N, Teunkens A, Vandermeersch E, Van de Velde M: A randomized trial comparing low-dose combined spinal-epidural anesthesia and conventional epidural anesthesia for cesarean section in severe preeclampsia. Acta Anaesthesiol Belg 2005; 56:155-162
161. Choi DH, Kim JA, Chung IS: Comparison of combined spinal epidural anesthesia and epidural anesthesia for cesarean section. Acta Anaesthesiol Scand 2000; 44:214-219
162. Davies SJ, Paech MJ, Welch H, Evans SF, Pavy TJG: Maternal experience during epidural or combined spinal-epidural anesthesia for cesarean section: A prospective, randomized trial. Anesth Analg 1997; 85:607-613
163. Karaman S, Akercan F, Akarsu T, Firat V, Ozcan O, Karadadas N: Comparison of the maternal and neonatal effects of epidural block and of combined spinal-epidural block for cesarean section. Eur J Obstet Gynecol Reprod Biol 2005; 121:18-23

164. Petropoulos G, Siristatidis C, Salamalekis E, Creatsas G: Spinal and epidural versus general anesthesia for elective cesarean section at term: effect on the acid-base status of the mother and newborn. J Matern Fetal Neonatal Med 2003;13:260-266
165. Rawal N, Schollin J, Westrom G: Epidural versus combined spinal epidural block for cesarean section. Acta Anaesthesiol Scan 1988; 32:61-66
166. Wallace DH, Leveno KJ, Cunningham FG, Giesecke AH, Shearer VE, Sidawi JE: Randomized comparison of general and regional anesthesia for cesarean delivery in pregnancies complicated by severe preeclampsia. Obstet Gynecol 1995; 86:193-199
167. Choi DH, Ahn HJ, Kim JA. Combined low-dose spinal-epidural anesthesia versus single-shot spinal anesthesia for elective cesarean delivery. Int J of Obstet Anesth 2006; 15:13-17
168. Choi DH, Park NK, Cho HS, Hahm TS, Chung IS: Effects of epidural injection on spinal block during combined spinal and epidural anesthesia for cesarean delivery. Reg Anesth Pain Med 2000; 25:591-595
169. Salman C, Kayacan N, Ertugrul F, Bigat Z, Karsh B: Combined spinal-epidural anesthesia with epidural volume extension causes a higher level of block than single-shot spinal anesthesia. Rev Bras Anestesiol 2013; 63:267-272
170. Thoren T, Holmstrom B, Rawal N, Schollin J, Lindeberg S, Skeppner G: Sequential combined spinal epidural block versus spinal block for cesarean section: effects on maternal hypotension and neurobehavioral function of the newborn. Anesth Analg 1994; 78:1087-1092
171. Tyagi A, Girotra G, Kumar A, Kumar S, Sethi A, Mohta M: Single-shot spinal anaesthesia, combined spinal-epidural and epidural volume extension for elective section: a randomized comparison. Int J Obstet Anesth 2009; 18:231-236
172. Husaini SW, Russell IF: Volume preload: lack of effect in the prevention of spinal-induced hypotension at caesarean section. Int J Obstet Anesth 1998; 7:76-81
173. Kamenik M, Paver-Erzen V: The effects of lactated Ringer's solution infusion on cardiac output changes after spinal anesthesia. *Anesth Analg* 2001; 92:710-714
174. Mojica JL, Melendez HJ, Bautista LE: The timing of intravenous crystalloid administration and incidence of cardiovascular side effects during spinal anesthesia: the results from a randomized controlled trial. *Anesth Analg* 2002; 94:432-437
175. Ngan Kee WD, Khaw KS, Lee BB, Ng FF, Wong MMS: Randomized controlled study of colloid preload before spinal anaesthesia for Caesarean section. Br J Anaesth 2001; 87:772-774
176. Ngan Kee WD, Khaw KS, Lee BB, Wong MM, Ng FF: Metaraminol infusion for maintenance of arterial blood pressure during spinal anesthesia for cesarean delivery: the effect of a crystalloid bolus. Anesth Analg 2001; 93:703-708
177. Nishikawa K, Yokoyama N, Saito S, Goto F: Comparison of effects of rapid colloid loading before and after spinal anesthesia on maternal hemodynamics and neonatal outcomes in cesarean section. *J Clin Monit Comput* 2007; 21:125-129
178. Lee SY, Choi DH, Park HW: The effect of colloid co-hydration on the use of phenylephrine and hemodynamics during low-dose combined spinal-epidural anesthesia for cesarean delivery. Korean J Anesthesiol 2008; 55:685-690
179. Kamenik M, Paver-Erzen V: The effects of lactated Ringer's solution infusion on cardiac output changes after spinal anesthesia. *Anesth Analg* 2001; 92:710-714
180. Mojica JL, Melendez HJ, Bautista LE: The timing of intravenous crystalloid administration and incidence of cardiovascular side effects during spinal anesthesia: the results from a randomized controlled trial. *Anesth Analg* 2002; 94:432-437

181. Nishikawa K, Yokoyama N, Saito S, Goto F: Comparison of effects of rapid colloid loading before and after spinal anesthesia on maternal hemodynamics and neonatal outcomes in cesarean section. *J Clin Monit Comput* 2007; 21:125-129
182. Carvalho B, Mercier FJ, Riley ET, Brummel C, Cohen SE: Hetastarch co-loading is as effective as pre-loading for the prevention of hypotension following spinal anesthesia for cesarean delivery. *Int J Obstet Anesth* 2009; 18:150-155
183. Nishikawa K, Yokoyama N, Saito S, Goto F: Comparison of effects of rapid colloid loading before and after spinal anesthesia on maternal hemodynamics and neonatal outcomes in cesarean section. *J Clin Monit Comput* 2007; 21:125-129
184. Oh AY, Hwang JW, Song IA, Kim MH, Ryu JH, Park HP, Jeon YT, Do SH: Influence of the timing of administration of crystalloid on maternal hypotension during spinal anesthesia for cesarean delivery: preload versus coload. *BMC Anesthesiol 2014; 14:36*
185. Siddik-Sayyid SM1, Nasr VG, Taha SK, Zbeide RA, Shehade JM, Al Alami AA, Mokadem FH, Abdallah FW, Baraka AS, Aouad MT: A randomized trial comparing colloid preload to coload during spinal anesthesia for elective cesarean delivery. *Anesth Analg 2009; 109:1219-1224*
186. Tawfik MM1, Hayes SM2, Jacoub FY2, Badran BA2, Gohar FM2, Shabana AM3, Abdelkhalek M2, Emara MM: Comparison between colloid preload and crystalloid co-load in cesarean section under spinal anesthesia: a randomized controlled trial. *Int J Obstet Anesth.* 2014; 23:317-323
187. Varshney R, Jain G: Comparison of colloid preload versus coload under low dose spinal anesthesia for cesarean delivery. *Anesth, Essays Res* 2013; 7:376-380
188. Desalu I, Kushimo OT: Is ephedrine infusion more effective at preventing hypotension than traditional prehydration during spinal anaesthesia for caesarean section in African parturients? Int J Obstet Anesth 2005; 14:294-299
189. King SW, Rosen MA: Prophylactic ephedrine and hypotension associated with spinal anesthesia for cesarean delivery. Int J Obstet Anesth 1998; 7:18-22
190. Loughrey JP, Walsh F, Gardiner J: Prophylactic intravenous bolus ephedrine for elective Caesarean section under spinal anaesthesia. Eur J Anaesthesiol 2002; 19:63-68
191. Ngan Kee WD, Khaw KS, Lee BB, Lau TK, Gin T: A dose-response study of prophylactic intravenous ephedrine for the prevention of hypotension during spinal anesthesia for cesarean delivery. Anesth Analg 2000; 90:1390-1395
192. Ramin SM, Ramin KD, Cox K, Magness RR, Shearer VE, Gant NF: Comparison of prophylactic angiotensin II versus ephedrine infusion for prevention of maternal hypotension during spinal anesthesia. Am J Obstet Gynecol 1994; 171:734-739
193. Ayorinde BT, Buczkowski P, Brown J, Shah J, Buggy DJ: Evaluation of pre-emptive intramuscular phenylephrine and ephedrine for reduction of spinal anaesthesia-induced hypotension during Caesarean section. Br J Anaesth 2001; 86:372-376
194. Gutsche BB: Prophylactic ephedrine preceding spinal analgesia for cesarean section. Anesthesiology 1976; 45:462-465
195. Webb AA, Shipton EA: Re-evaluation of i.m. ephedrine as prophylaxis against hypotension associated with spinal anaesthesia for Caesarean section. Can J Anaesth 1998; 45:367-369
196. Allen T, George R, White W, Muir H, Habib A: A double-blind, placebo-controlled trial of four fixed rate infusion regimens of phenylephrine for hemodynamic support during spinal anesthesia for cesarean delivery. Anesth Analg 2010; 111:1221-1229
197. Langesaeter E, Rosseland L A, Stubhaug A: Continuous invasive blood pressure and cardiac output monitoring during cesarean delivery. Anesthesiology 2008; 109:856-863
198. Siddik-Sayyid S, Taha S, Kanazi E, Aouad: A randomized controlled trial of variable rate phenylephrine infusion with rescue phenylephrine boluses versus rescue boluses alone on

physician interventions during spinal anesthesia for elective cesrean delivery. Anesth Analg 2014; 118:611-618

199. Alahuhta S, Rasanen J, Jouppila P, Hollmen AI: Ephedrine and phenylephrine for avoiding maternal hypotension due to spinal anaesthesia for caesarean section. Int J Obstet Anesth 1992; 1:129-134
200. Cooper DW, Carpenter M, Mowbray P, Desira WR, Ryall DM, Kokri MS: Fetal and maternal effects of phenylephrine and ephedrine during spinal anesthesia for cesarean delivery. Anesthesiology 2002; 97:1582-1590
201. Cooper DW, Jeyaraj L, Hynd R, Thompson R, Meek T, Ryall DM, Kokri MS: Evidence that intravenous vasopressors can affect rostral spread of spinal anesthesia in pregnancy. Anesthesiology 2004; 101:28-33
202. Hall PA, Bennett A, Wilkes MP, Lewis M: Spinal anaesthesia for caesarean section: comparison of infusions of phenylephrine and ephedrine. Br J Anaesth 1994; 73:471-474
203. Ngan Kee WD, Khaw KS, Tan PE, Ng FF, Karmakar MK: Placental transfer and fetal metabolic effects of phenylephrine and ephedrine during spinal anesthesia for cesarean delivery. Anesthesiology 2009; 111: 506-512
204. Ngan Kee WD, Lee A, Khaw KS, Ng FF, Karmakar MK, Gin T: A randomized double-blinded comparison of phenylephrine and ephedrine combinations given by infusion to maintain blood pressure during spinal anesthesia for cesarean delivery: effects on fetal acid-base status and hemodynamic control. Anesth Analg 2008; 107:1295– 1302
205. Dyer R, Reed An, vanDyk D, Arcache M, Hodges O, Lombard C, Greenwood J, James M: Hemodynamic effects of ephedrine, phenylephrine, and the coadministration of phenylephrine with oxytocin during spinal anesthesia for elective cesarean delivery. Anesthesiology 2009; 111:753-765
206. LaPorta RF, Arthur GR, Datta S: Phenylephrine in treating maternal hypotension due to spinal anaesthesia for caesarean delivery: effects on neonatal cathecholamine concentrations, acid base status and Apgar scores. Acta Anaesth Scand 1995; 39:901-905
207. Moran DH, Perillo M, LaPorta RF, Bader AM, Datta S: Phenylephrine in the prevention of hypotension following spinal anesthesia for cesarean delivery. J Clin Anesth 1991; 3:301-305
208. Pierce ET, Carr DB, Datta S: Effects of ephedrine and phenylephrine on maternal and fetal atrial natriuretic peptide levels during elective cesarean section. Acta Anaesth Scand 1994; 38:48-51
209. Prakash S, Pramanik V, Chellani H, Salhan S, Gogia A: Maternal and neonatal effects of bolus administration of ephedrine and phenylephrine during spinal anaesthesia for caesarean delivery: a randomised study. Int J Obstet Anesth 2010; 19:24-30
210. Saravanan S, Kocarev M, Wilson RC, Watkins E, Columb MO, Lyons G: Equivalent dose of ephedrine and phenylephrine in the prevention of post-spinal hypotension in Caesarean section. Br J Anaesth 2006; 96:95-99
211. Daley MD, Sandler AN, Turner KE, Vosu H, Slavchenko P: A comparison of epidural and intramuscular morphine in patients following cesarean section. Anesthesiology 1990, 72:289-294
212. Eisenach JC, Grice SC, Dewan DM. Patient-controlled analgesia following cesarean section: a comparison with epidural and intramuscular narcotics. Anesthesiology 1988; 68:444-448
213. Harrison DM, Sinatra R, Morgese L, Chung JH: Epidural narcotic and patient-controlled analgesia for post-cesarean section pain relief. Anesthesiology 1988; 68:454-457
214. Henderson SK, Matthew E, Cohen H, Avram MJ: Epidural hydromorphone: A double blind comparison with intramuscular hydromorphone for postcesarean section analgesia. Anesthesiology 1987; 66:825-830
215. Macrae DJ, Munishankrappa S, Burrow LM, Milne MK, Grant IS: Double-blind comparison of the efficacy of extradural diamorphine, extradural phenoperidine and i.m. diamorphine following caesarean section. Br J Anaesth 1987, 59:354-359
216. Perriss BW, Latham BV, Wilson IH: Analgesia following extradural and i.m. pethidine in post-caesarean section patients. Br J Anaesth 1990, 64:355-357

217. Smith ID, Klubien KE, Wood MLB, Macrae DJ, Carli F: Diamorphine analgesia after caesarean section: comparison of intramuscular and epidural administration of four dose regimens. Anaesthesia 1991, 46:973-976
218. Chambers WA, Mowbray A, Wilson J: Extradural morphine for the relief of pain following caesarean section. Br J Anaesth 1983, 55:1201-1203
219. Cohen S, Pantuck CB, Amar D, Burley E, Pantuck EJ: The primary action of epidural fentanyl after cesarean delivery is via a spinal mechanism. Anesth Analg 2002; 94:674-679
220. Cohen SE, Tan S, White PF: Sufentanil analgesia following cesarean section: Epidural versus intravenous administration. Anesthesiology 1988, 68:129-134
221. Daley MD, Sandler AN, Turner KE, Vosu H, Slavchenko P: A comparison of epidural and intramuscular morphine in patients following cesarean section. Anesthesiology 1990, 72:289-294
222. Parker RK, White PF: Epidural patient-controlled analgesia: an alternative to intravenous patient-controlled analgesia for pain relief after cesarean delivery. Anesth Analg 1992, 75:245-251
223. Rosen MA, Hughes SC, Shnider SM, Abboud TK, Norton M, Dailey PA, Curtis JD: Epidural morphine for the relief of postoperative pain after cesarean delivery. Anesth Analg 1983, 62:666-672
224. Alfirevic Z, Elbourne D, Pavord S, Bolte An, Van Geijin H, Mercier F, Ahonen J, Bremme K, Bodker B, Magnusdottir E, Salvesen K, Prendiville W, Truesdale A, Clemens F, Piercy D, Gyte G: Primary postpartum hemorrhage-the Northern European Registry 200-2004. Obstet Gynecol 2007; 110:1270-1278
225. King M, Wrench I, Galimberti A, Spray R: Introduction of cell salvage to a large obstetric unit: the first six months. Int J Obstet Anesth 2009; 18:111-117
226. Kjaer K, Comerford M, Gadalla F: General anesthesia for cesarean delivery in a patient with paroxysmal nocturnal hemoglobinuria and thrombocytopenia. Anesth Analg 2004; 98: 1471-1472
227. Lilker S, Meyer, R, Downey K, Macarthur A: Anesthetic considerations for placenta accreta. Int J Obstet Anesth 2011; 20:288-292
228. Margarson MP: Delayed amniotic fluid embolism following caesarean section under spinal anaesthesia. Anaesthesia 1995; 50:804-806
229. Nagy C, Wheeler A, Archer T: Acute normovolemic hemodilution, intraoperative cell salvage and Pulse CO hemodynamic monitoring in a Jehovah's Witness with placenta percreta. Int J Obstet Anesth 2008; 17:159-163
230. Potter PS, Waters JH, Burger GA, Mraovic B: Application of cell-salvage during cesarean section. Anesthesiology 1999; 90:619-621
231. Rogers W, Wernimont S, Kumar G, Bennett E, Chestnut D: Acute hypotension associated with intraoperative cell salvage using a leukocyte depletion filter during management of obstetric hemorrhage due to amniotic fluid embolism. Anesth Anag 2013; 117:449-452
232. Ferouz F, Norris MC, Leighton BL: Risk of respiratory arrest after intrathecal sufentanil. Anesth Analg 1997; 85:1088-1090
233. Godley M, Reddy AR: Use of LMA for awake intubation for caesarean section. Can J Anaesth 1996; 43:299-302
234. Greenhalgh CA: Respiratory arrest in a parturient following intrathecal injection of sufentanil and bupivacaine. Anaesthesia 1996; 51:173-175
235. Hawksworth CR, Purdie J: Failed combined spinal epidural then failed intubation at an elective caesarean section. Hosp Med 1998; 59:173
236. Hinchliffe D, Norris A: Management of failed intubation in a septic parturient. Br J Anaesth 2002; 89:328-330
237. Kehl F, Erfkamp S, Roewer N: Respiratory arrest during caesarean section after intrathecal administration of sufentanil in combination with 0.1% bupivacaine 10 ml. Anaesth Intensive Care 2002; 30:698-699

238. Keller C, Brimacombe J, Lirk P, Puhringer F: Failed obstetric tracheal intubation and postoperative respiratory support with the ProSeal laryngeal mask airway. Anesth Analg 2004; 98:1467-1470
239. McDonnell, N, Paech M, Clavisi O, Scott K (ANZCA Trials Group): Difficult and failed intubation in obstetric anaesthesia: an observational study of airway management and complications associated with general anaesthesia for caesarean section. Int J Obstet Anesth 2008; 17:292-297
240. Parker J, Balis N, Chester S, Adey D: Cardiopulmonary arrest in pregnancy: successful resuscitation of mother and infant following immediate caesarean section in labour ward. Aust N Z J Obstet Gynaecol 1996; 36:207-210
241. Popat MT, Chippa JH, Russell R: Awake fibreoptic intubation following failed regional anaesthesia for caesarean section in a parturient with Still's disease. Eur J Anaesthesiol 2000; 17:211-214

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Appendix 1: Summary of Recommendations

Perianesthetic Evaluation and Preparation

History and physical examination:

- Conduct a focused history and physical examination before providing anesthesia care.
  - This should include, but is not limited to, a maternal health and anesthetic history, a relevant obstetric history, a baseline blood pressure measurement, and an airway, heart, and lung examination, consistent with the ASA "Practice Advisory for Preanesthesia Evaluation."[†††††].
  - When a neuraxial anesthetic is planned or placed, examine the patient's back.
  - Recognition of significant anesthetic or obstetric risk factors should encourage consultation between the obstetrician and the anesthesiologist.
- A communication system should be in place to encourage early and ongoing contact between obstetric providers, anesthesiologists, and other members of the multidisciplinary team.

Intrapartum platelet count:

- The anesthesiologist's decision to order or require a platelet count should be individualized and based on a patient's history (*e.g.*, preeclampsia), physical examination and clinical signs.[‡‡‡‡‡]
  - A routine platelet count is not necessary in the healthy parturient.

Blood type and screen:

- A routine blood cross-match is not necessary for healthy and uncomplicated parturients for vaginal or operative delivery.
- The decision whether to order or require a blood type and screen or cross-match should be based on maternal history, anticipated hemorrhagic complications (*e.g.*, placenta accreta in a patient with placenta previa and previous uterine surgery), and local institutional policies.

Perianesthetic recording of fetal heart rate patterns:

- Fetal heart rate patterns should be monitored by a qualified individual before and after administration of neuraxial analgesia for labor.
  - *Continuous* electronic recording of fetal heart rate patterns may not be necessary in every clinical setting and may not be possible during initiation of neuraxial anesthesia.

Aspiration Prevention

Clear liquids:

- The oral intake of moderate amounts of clear liquids may be allowed for uncomplicated laboring patients.
- The uncomplicated patient undergoing elective surgery may have moderate amounts of clear liquids up to 2 h before induction of anesthesia.

[†††††] Practice Advisory for Preanesthesia Evaluation: an Updated Report by the American Society of Anesthesiologists Task Force on Preanesthesia Evaluation. Anesthesiology 2012; 116:522-538.

[‡‡‡‡‡] A specific platelet count predictive of neuraxial anesthetic complications has not been determined.

733 - Examples of clear liquids include, but are not limited to, water, fruit juices
734 without pulp, carbonated beverages, clear tea, black coffee, and sports drinks.
735 - The volume of liquid ingested is less important than the presence of
736 particulate matter in the liquid ingested.
737 • Laboring patients with additional risk factors for aspiration (*e.g.*, morbid obesity,
738 diabetes, difficult airway), or patients at increased risk for operative delivery (*e.g.*,
739 nonreassuring fetal heart rate pattern) may have further restrictions of oral intake,
740 determined on a case-by-case basis.

741 *Solids:*

742 • Solid foods should be avoided in laboring patients.
743 • The patient undergoing elective surgery (*e.g.*, scheduled cesarean delivery or
744 postpartum tubal ligation) should undergo a fasting period for solids of 6 to 8 hours
745 depending on the type of food ingested (*e.g.*, fat content).[§§§§§]
746 - Adherence to a predetermined fasting period before non-elective surgical
747 procedures may not always be possible due to the uncertain timing of delivery
748 for laboring patients.

749 *Antacids, H_2 Receptor Antagonists, and Metoclopramide:*

750 • Before surgical procedures (*e.g.*, cesarean delivery, postpartum tubal ligation),
751 consider the timely administration of non-particulate antacids, H_2 receptor
752 antagonists, and/or metoclopramide for aspiration prophylaxis.

753 **Anesthetic Care for Labor and Delivery**

754 *Timing of Neuraxial Analgesia and Outcome of Labor*.

755 • Provide patients in early labor (*i.e.*, < 5 cm dilation) the option of neuraxial
756 analgesia when this service is available.
757 • Offer neuraxial analgesia on an individualized basis regardless of cervical dilation.
758 - Reassure patients that the use of neuraxial analgesia does not increase the
759 incidence of cesarean delivery.

760 *Neuraxial Analgesia and Trial of Labor after Prior Cesarean Delivery.*

761 • Offer neuraxial techniques to patients attempting vaginal birth after previous cesarean
762 delivery.
763 • For these patients, consider early placement of a neuraxial catheter that can be used
764 later for labor analgesia, or for anesthesia in the event of operative delivery.

765 *Analgesia/Anesthetic Techniques.*

766 *Early insertion of a neuraxial (i.e., spinal or epidural) catheter for complicated*
767 *parturients:*

768 • Consider early insertion of a neuraxial catheter for obstetric (*e.g.*, twin gestation or
769 preeclampsia) or anesthetic indications (*e.g.*, anticipated difficult airway or obesity)
770 to reduce the need for general anesthesia if an emergent procedure becomes
771 necessary.

[§§§§§] Practice guidelines for preoperative fasting and the use of pharmacologic agents to reduce the risk of pulmonary aspiration: an Updated Report by the American Society of Anesthesiologists Task Force on Preoperative Fasting. ANESTHESIOLOGY 2011; 114:495-511.

- In these cases, the insertion of a neuraxial catheter may precede the onset of labor or a patient's request for labor analgesia.

Continuous infusion epidural analgesia (CIE):

- Continuous epidural infusion may be used for effective analgesia for labor and delivery.
- When a continuous epidural infusion of local anesthetic is selected, an opioid may be added to reduce the concentration of local anesthetic, improve the quality of analgesia, and minimize motor block.

Analgesic concentrations:

- Use dilute concentrations of local anesthetics with opioids to produce as little motor block as possible

Single-injection spinal opioids with or without local anesthetics:

- Single-injection spinal opioids with or without local anesthetics may be used to provide effective, although time-limited, analgesia for labor when spontaneous vaginal delivery is anticipated.
- If labor duration is anticipated to be longer than the analgesic effects of the spinal drugs chosen, or if there is a reasonable possibility of operative delivery, then consider a catheter technique instead of a single injection technique.
- A local anesthetic may be added to a spinal opioid to increase duration and improve quality of analgesia.[******]

Pencil-Point Spinal Needles:

- Use pencil-point spinal needles instead of cutting-bevel spinal needles to minimize the risk of postdural puncture headache.

Combined spinal-epidural analgesia:

- If labor duration is anticipated to be longer than the analgesic effects of the spinal drugs chosen, or if there is a reasonable possibility of operative delivery, then consider a catheter technique instead of a single injection technique.
- Combined spinal-epidural techniques may be used to provide effective and rapid onset of analgesia for labor.

Patient-controlled epidural analgesia (PCEA):

- PCEA may be used to provide an effective and flexible approach for the maintenance of labor analgesia.
- The use of PCEA may be preferable to fixed-rate CIE for administering reduced dosages of local anesthetics.
- PCEA may be used with or without a background infusion.

Removal of Retained Placenta

Anesthetic techniques:

- In general, there is no preferred anesthetic technique for removal of retained placenta.

[******] The Task Force notes that the rapid onset of analgesia provided by single-injection spinal techniques may be advantageous for selected patients (*e.g.*, those in advanced labor).

    - If an epidural catheter is in place and the patient is hemodynamically stable, consider providing epidural anesthesia.
- Assess hemodynamic status before administering neuraxial anesthesia.
- Consider aspiration prophylaxis.
- Titrate sedation/analgesia carefully due to the potential risks of respiratory depression and pulmonary aspiration during the immediate postpartum period.
- In cases involving major maternal hemorrhage with hemodynamic instability, general anesthesia with an endotracheal tube may be considered in preference to neuraxial anesthesia.

Nitroglycerin for uterine relaxation:

- Nitroglycerin may be used as an alternative to terbutaline sulfate or general endotracheal anesthesia with halogenated agents for uterine relaxation during removal of retained placental tissue.
    - Initiating treatment with incremental doses of intravenous or sublingual (*i.e.*, tablet or metered dose spray) nitroglycerin may be done to sufficiently relax the uterus.

Anesthetic Care for Cesarean Delivery

Equipment, Facilities, and Support Personnel:

- Equipment, facilities, and support personnel available in the labor and delivery operating suite should be comparable to those available in the main operating suite.
- Resources for the treatment of potential complications (*e.g.*, failed intubation, inadequate analgesia, hypotension, respiratory depression, pruritus, vomiting) should also be available in the labor and delivery operating suite.
- Appropriate equipment and personnel should be available to care for obstetric patients recovering from neuraxial or general anesthesia.

General, epidural, spinal, or CSE anesthesia:

- The decision to use a particular anesthetic technique for cesarean delivery should be individualized, based on anesthetic, obstetric or fetal risk factors (*e.g.*, elective *vs.* emergency), the preferences of the patient, and the judgment of the anesthesiologist.
    - Uterine displacement (usually left displacement) should be maintained until delivery regardless of the anesthetic technique used.
- Consider selecting neuraxial techniques in preference to general anesthesia for most cesarean deliveries.
- If spinal anesthesia is chosen, use pencil-point spinal needles instead of cutting-bevel spinal needles.
- For urgent cesarean delivery, an indwelling epidural catheter may be used as an alternative to initiation of spinal or general anesthesia.
- General anesthesia may be the most appropriate choice in some circumstances (*e.g.*, profound fetal bradycardia, ruptured uterus, severe hemorrhage, severe placental abruption).

Intravenous Fluid Preloading or Coloading:

- Intravenous fluid preloading or coloading may be used to reduce the frequency of maternal hypotension following spinal anesthesia for cesarean delivery.

- Do not delay the initiation of spinal anesthesia in order to administer a fixed volume of intravenous fluid.

Ephedrine or phenylephrine:

- Either intravenous ephedrine or phenylephrine may be used for treating hypotension during neuraxial anesthesia.
- In the absence of maternal bradycardia, consider selecting phenylephrine because of improved fetal acid-base status in uncomplicated pregnancies.

Neuraxial Opioids for Postoperative Analgesia:

- For postoperative analgesia after neuraxial anesthesia for cesarean delivery, consider selecting neuraxial opioids rather than intermittent injections of parenteral opioids.

Postpartum Tubal Ligation

- Before a postpartum tubal ligation, the patient should have no oral intake of solid foods within 6 - 8 h of the surgery, depending on the type of food ingested (*e.g.*, fat content).[††††††]
- Consider aspiration prophylaxis.
- Both the timing of the procedure and the decision to use a particular anesthetic technique (*i.e.*, neuraxial *vs.* general) should be individualized, based on anesthetic and obstetric risk factors (*e.g.*, blood loss), and patient preferences.
- Consider selecting neuraxial techniques in preference to general anesthesia for most postpartum tubal ligations.
    - Be aware that gastric emptying will be delayed in patients who have received opioids during labor.
    - Be aware that an epidural catheter placed for labor may be more likely to fail with longer post-delivery time intervals.
    - If a postpartum tubal ligation is to be performed before the patient is discharged from the hospital, do not attempt the procedure at a time when it might compromise other aspects of patient care on the labor and delivery unit.

Management of Obstetric and Anesthetic Emergencies

Resources for Management of Hemorrhagic Emergencies:

- Institutions providing obstetric care should have resources available to manage hemorrhagic emergencies (table 1).
    - In an emergency, type-specific or O negative blood is acceptable.
    - In cases of intractable hemorrhage when banked blood is not available or the patient refuses banked blood, consider intraoperative cell-salvage if available.[‡‡‡‡‡‡]

[††††††] Practice guidelines for preoperative fasting and the use of pharmacologic agents to reduce the risk of pulmonary aspiration: an Updated Report by the American Society of Anesthesiologists Task Force on Preoperative Fasting. ANESTHESIOLOGY 2011; 114:495-511.

[‡‡‡‡‡‡] Practice Guidelines for Perioperative Blood Management: an Updated Report by the American Society of Anesthesiologists Task Force on Perioperative Blood Management. ANESTHESIOLOGY 2015; 122:241-275.

Equipment for Management of Airway Emergencies:

- Labor and delivery units should have personnel and equipment readily available to manage airway emergencies consistent with the ASA Practice Guidelines for Management of the Difficult Airway,[§§§§§§] to include a pulse oximeter and carbon dioxide detector.
    - Basic airway management equipment should be immediately available during the provision of neuraxial analgesia (table 2).
    - Portable equipment for difficult airway management should be readily available in the operative area of labor and delivery units (table 3).
    - A preformulated strategy for intubation of the difficult airway should be in place.
    - When tracheal intubation has failed, consider ventilation with mask and cricoid pressure, or with a supraglottic airway device (*e.g.*, laryngeal mask airway, intubating laryngeal mask airway, laryngeal tube) for maintaining an airway and ventilating the lungs.
    - If it is not possible to ventilate or awaken the patient, create an airway surgically.

Cardiopulmonary Resuscitation:

- Basic and advanced life-support equipment should be immediately available in the operative area of labor and delivery units.
- If cardiac arrest occurs, initiate standard resuscitative measures.
    - Uterine displacement (usually left displacement) should be maintained.
    - If maternal circulation is not restored within 4 min, cesarean delivery should be performed by the obstetrics team.[*******]

[§§§§§§] American Society of Anesthesiologists Task Force on Management of the Difficult Airway: Practice guidelines for management of the difficult airway: An Updated Report. ANESTHESIOLOGY 2013; 118:251-270.

[*******] More information on management of cardiac arrest can be found in: Lipman S, Cohen S, Einav S, Jeejeebhoy F, Mhyre JM, Morrison LJ, Katz V, Tsen LC, Daniels K, Halamek LP, Suresh MS, Arafeh J, Gauthier D, Carvalho JC, Druzin M, Carvalho B; Society for Obstetric Anesthesia and Perinatology: The Society for Obstetric Anesthesia and Perinatology consensus statement on the management of cardiac arrest in pregnancy. Anesth Analg. 2014 May;118(5):1003.

*Table 1. Suggested Resources for Obstetric Hemorrhagic Emergencies**

- Large bore intravenous catheters
- Fluid warmer
- Forced air body warmer
- Availability of blood bank resources
- Massive transfusion protocol
- Equipment for infusing intravenous fluids and blood products rapidly. Examples include, but are not limited to, hand squeezed fluid chambers, hand inflated pressure bags, and automatic infusion devices.

* The items listed represent suggestions. The items should be customized to meet the specific needs, preferences, and skills of the practitioner and health-care facility.

*Table 2. Suggested Resources for Airway Management During Initial Provision of Neuraxial Analgesia in an LDR Setting**

- Laryngoscope and assorted blades
- Endotracheal tubes, with stylets
- Oxygen source
- Suction source with tubing and tonsil suction tip
- Self-inflating bag and mask for positive pressure ventilation.
- Medications for blood pressure support, muscle relaxation, and hypnosis
- Qualitative carbon dioxide detector
- Pulse oximeter

* The items listed represent suggestions. The items should be customized to meet the specific needs, preferences, and skills of the practitioner and health-care facility.

Table 3. Suggested Contents of a Portable Storage Unit for Difficult Airway Management for Cesarean Section Rooms [1]

- Rigid laryngoscope blades of alternate design and size
- Videolaryngoscopic devices
- Endotracheal tubes of assorted size
- Endotracheal tube guides. Examples include (but are not limited to) semi-rigid stylets, light wands, and forceps designed to manipulate the distal portion of the endotracheal tube.
- At least one device suitable for emergency non-surgical airway ventilation consisting of a face mask or supraglottic airway device (*e.g.*, laryngeal mask airway, intubating laryngeal mask airway, laryngeal tube).
- Equipment suitable for emergency surgical airway access (*e.g.*, cricothyrotomy)
- An exhaled carbon dioxide detector
- Topical anesthetics and vasoconstrictors

[1] Adapted from the Practice guidelines for management of the difficult airway: An Updated Report. ANESTHESIOLOGY 2013; 118:251-270. The items listed represent suggestions. The items should be customized to meet the specific needs, preferences, and skills of the practitioner and health-care facility.

Appendix 2: Overview of Anesthetic Care for Labor and Delivery[†††††††]

Not all women require anesthetic care during labor or delivery. For women who request pain relief for labor and/or delivery, there are many effective analgesic techniques available. Maternal request represents sufficient justification for pain relief. In addition, maternal medical and obstetric conditions may warrant the provision of neuraxial techniques to improve maternal and neonatal outcome.

The choice of analgesic technique depends on the medical status of the patient, progress of labor, and resources at the facility. When sufficient resources (*e.g.*, anesthesia and nursing staff) are available, neuraxial catheter techniques should be one of the analgesic options offered. The choice of a specific neuraxial technique should be individualized and based on anesthetic risk factors, obstetric risk factors, patient preferences, progress of labor, and resources at the facility. When neuraxial techniques are used for analgesia during labor or vaginal delivery, the primary goal is to provide adequate maternal analgesia with minimal motor block (*e.g.*, achieved with the administration of local anesthetics at low concentrations with or without opioids).

When a neuraxial technique is chosen, appropriate resources for the treatment of complications (*e.g.*, hypotension, systemic toxicity, high spinal anesthesia) should be available. If an opioid is added, treatments for related complications (*e.g.*, pruritus, nausea, respiratory depression) should be available. An intravenous infusion should be established before the initiation of neuraxial analgesia or general anesthesia and maintained throughout the duration of the neuraxial analgesic or anesthetic. However, administration of a fixed volume of intravenous fluid is not required before neuraxial analgesia is initiated.

[†††††††] The information in this appendix is intended to provide overview and context for issues concerned with anesthetic care for labor and delivery, and are not Guideline recommendations.

Appendix 3: Methods and Analyses

A. State of the Literature.

For these updated Guidelines, a review of studies used in the development of the previous update was combined with studies published subsequent to approval of the update in 2006.[‡‡‡‡‡‡‡] The scientific assessment of these Guidelines was based on evidence linkages or statements regarding potential relationships between clinical interventions and outcomes. The interventions listed below were examined to assess their relationship to a variety of outcomes related to obstetric anesthesia.[§§§§§§§]

Preanesthetic evaluation and preparation:

- Conducting a focused history (patient condition)
- Conducting a physical examination
- Communication between anesthetic and obstetric providers
- Laboratory tests
  - Routine intrapartum platelet count
  - Platelet count for suspected preeclampsia or coagulopathy
  - Blood type and screen or crossmatch
- Recording of fetal heart rate patterns

Aspiration prevention:

- Oral intake of clear liquids for laboring patients
- Oral intake of solids for laboring patients
- A fasting period for solids of 6 to 8 hours before an elective cesarean
- Non-particulate antacids versus no antacids prior to operative procedures (excluding operative vaginal delivery)
- H_2 receptor antagonists (*e.g.*, cimetidine, ranitidine, famotidine) versus no H_2 antagonists prior to operative procedures (excluding operative vaginal delivery)
- Metoclopramide versus no metoclopramide prior to operative procedures (excluding operative vaginal delivery)

Anesthetic care for labor and vaginal delivery:

- Early versus late administration of neuraxial analgesia (*e.g.*, cervical dilations of < 5 vs > 5 cm or < 4 vs > 4 cm)
- Neuraxial techniques for patients attempting vaginal birth after prior cesarean delivery (VBAC) for labor

‡‡‡‡‡‡‡ Practice Guidelines for Obstetric Anesthesia: an Updated Report by the American Society of Anesthesiologists Task Force on Obstetric Anesthesia. Anesthesiology 2007; 106:843-863.

§§§§§§§ Unless otherwise specified, outcomes for the listed interventions refer to the reduction of maternal, fetal and neonatal complications.

- Prophylactic neuraxial catheter insertion for obstetric (*e.g.*, twin gestation or preeclampsia) or anesthetic indications (*e.g.*, anticipated difficult airway or obesity)
- Continuous epidural infusion (CIE) of local anesthetics
    - CIE of local anesthetics (with or without opioids) versus IM opioids for labor
    - CIE of local anesthetics (with or without opioids) versus IV opioids for labor
    - CIE of local anesthetics with or without opioids versus spinal opioids with or without local anesthetics for labor
- *Analgesic concentrations:*
    - Induction of epidural analgesia using local anesthetics with opioids versus equal concentrations of epidural local anesthetics without opioids for labor
    - Induction of epidural analgesia using local anesthetics with opioids versus higher concentrations of epidural local anesthetics without opioids for labor
    - Maintenance of epidural infusion of lower concentrations of local anesthetics with opioids versus higher concentrations of local anesthetics without opioids for labor
    - Maintenance of epidural infusion with bupivacaine concentrations < 0.125% with opioids versus bupivacaine concentrations > 0.125% without opioids for labor
- *Single-injection spinal opioids:*
    - Single-injection spinal opioids with or without local anesthetics versus parenteral opioids for labor
    - Single-injection spinal opioids with local anesthetics versus spinal opioids without local anesthetics for labor
- *Pencil-point spinal needles:*
    - Pencil-point spinal needles versus cutting-bevel spinal needles
- *CSE local anesthetics with opioids:*
    - CSE local anesthetics with opioids versus epidural local anesthetics with opioids for labor
- *Patient-controlled epidural analgesia (PCEA):*
    - PCEA versus continuous infusion epidurals (CIE) for labor
    - PCEA with a background infusion versus PCEA without a background infusion for labor
- *Removal of Retained Placenta:*
    - Anesthetic techniques
    - Administration of nitroglycerin for uterine relaxation

Anesthetic care for cesarean delivery:

- *Equipment, facilities, and support personnel:*
    - Availability of equipment, facilities, and support personnel
- *General, epidural, spinal, or CSE anesthesia:*
    - General anesthesia (GA) versus epidural anesthesia
    - Epidural versus spinal anesthesia
    - Combined spinal-epidural (CSE) anesthesia versus epidural anesthesia
        - CSE anesthesia versus epidural anesthesia
        - CSE anesthesia versus spinal anesthesia
    - In situ epidural catheter versus no epidural anesthesia in hemodynamically stable patients for removal of retained placenta
    - General anesthesia (GA) vs neuraxial anesthesia in cases involving major maternal hemorrhage for removal of retained placenta

- *Intravenous fluid preloading or coloading:*
  - Intravenous fluid preloading or coloading versus no intravenous fluid preloading or coloading for spinal anesthesia to reduce maternal hypotension
  - Intravenous fluid preloading versus coloading
- *Ephedrine or phenylephrine:*
  - Ephedrine vs placebo or no ephedrine
  - Phenylephrine vs placebo or no ephedrine
  - Ephedrine versus phenylephrine
- *Neuraxial opioids for postoperative analgesia:*
  - Neuraxial opioids versus intermittent injections of parenteral opioids for postoperative analgesia after neuraxial anesthesia for cesarean
  - Patient-controlled epidural analgesia (PCEA) versus IV PCA for postoperative analgesia after neuraxial anesthesia for cesarean
  - Addition of NSAIDS vs no NSAIDS for postoperative analgesia after neuraxial anesthesia for cesarean

Postpartum tubal ligation:

- A fasting period for solids of 6 to 8 hours before postpartum tubal ligation
- Aspiration prophylaxis for postpartum tubal ligation
- Neuraxial anesthesia versus general anesthesia for postpartum tubal ligation
- Postpartum tubal ligation within 8 hours of delivery

Management of obstetric and anesthetic emergencies:

Resources for management of hemorrhagic emergencies:

- Equipment, facilities, and support personnel available in the labor and delivery suite comparable to that available in the main operating suite
- Resources for management of hemorrhagic emergencies (e.g., RBCs, platelets, cell-salvage)
- Invasive hemodynamic monitoring for severe preeclamptic patients

Resources for management of airway emergencies:

- Equipment for management of airway emergencies

Cardiopulmonary resuscitation:

- Basic and advanced life-support equipment in the labor and delivery suite

For the literature review, potentially relevant clinical studies were identified *via* electronic and manual searches of the literature. The updated searches covered an 11-year period from 2005 through 2015. Over 2000 new citations that addressed topics related to the evidence linkages were identified. These articles were reviewed and those meeting the appropriate criteria as outlined in the “Focus” section above were combined with pre-2005 articles used in the

previous update, resulting in a total of 481 articles that contained direct linkage-related evidence. A complete bibliography used to develop these Guidelines, organized by section, is available as Supplemental Digital Content 2, http://links.lww.com/ALN/___.

Initially, each pertinent outcome reported in a study was classified as supporting an evidence linkage, refuting a linkage, or equivocal. The results were then summarized to obtain a directional assessment for each evidence linkage before conducting a formal meta-analysis. Literature pertaining to 13 evidence linkages contained enough studies with well-defined experimental designs and statistical information sufficient for meta-analyses. These linkages were: (1) early *versus* late epidural anesthetics, (2) epidural local anesthetics with opioids *versus* equal concentrations of epidural local anesthetics without opioids, (3) continuous epidural infusion of local anesthetics with opioids *versus* higher concentrations of local anesthetics without opioids, (4) pencil-point versus cutting-bevel spinal needles (5) CSE local anesthetics with opioids *versus* epidural local anesthetics with opioids, (6) PCEA *versus* continuous infusion epidural anesthetics, (7) PCEA with a background infusion versus PCEA, (8) general anesthesia *versus* epidural anesthesia for cesarean delivery, (9), CSE anesthesia *versus* epidural anesthesia for cesarean delivery, (10), fluid preloading *versus* coloading for cesarean delivery, (11) ephedrine *versus* placebo for cesarean delivery, (12) ephedrine *versus* phenylephrine for cesarean delivery, and (13 neuraxial *versus* parenteral opioids for postoperative analgesia.

General variance-based effect-size estimates or combined probability tests were obtained for continuous outcome measures, and Mantel-Haenszel odds-ratios were obtained for dichotomous outcome measures. Two combined probability tests were employed as follows: (1) the Fisher combined test, producing chi-square values based on logarithmic transformations of the reported P values from the independent studies, and (2) the Stouffer combined test, providing weighted representation of the studies by weighting each of the standard normal deviates by the size of the sample. An odds-ratio procedure based on the Mantel-Haenszel method for combining study

results using 2 x 2 tables was used with outcome frequency information. An acceptable significance level was set at $P < 0.01$ (one-tailed). Tests for heterogeneity of the independent studies were conducted to assure consistency among the study results. DerSimonian-Laird random-effects odds ratios were obtained when significant heterogeneity was found ($P < 0.01$). To control for potential publishing bias, a "fail-safe n" value was calculated. No search for unpublished studies was conducted, and no reliability tests for locating research results were done. To be accepted as significant findings, Mantel-Haenszel odds-ratios must agree with combined test results whenever both types of data are assessed. In the absence of Mantel-Haenszel odds-ratios, findings from both the Fisher and weighted Stouffer combined tests must agree with each other to be acceptable as significant.

For the previous update, interobserver agreement among Task Force members and two methodologists was established by interrater reliability testing. Agreement levels using a κ statistic for two-rater agreement pairs were as follows: (1) type of study design, $\kappa = 0.83\text{-}0.94$; (2) type of analysis, $\kappa = 0.71\text{-}0.93$; (3) evidence linkage assignment, $\kappa = 0.87\text{-}1.00$; and (4) literature inclusion for database, $\kappa = 0.74\text{-}1.00$. Three-rater chance-corrected agreement values were: (1) study design, Sav = 0.884, Var (Sav) = 0.004; (2) type of analysis, Sav = 0.805, Var (Sav) = 0.009; (3) linkage assignment, Sav = 0.911, Var (Sav) = 0.002; (4) literature database inclusion, Sav = 0.660, Var (Sav) = 0.024. These values represent moderate to high levels of agreement.

B. Consensus-Based Evidence.

For the previous update, consensus was obtained from multiple sources, including: (1) survey opinion from consultants who were selected based on their knowledge or expertise in obstetric anesthesia or maternal and fetal medicine, (2) survey opinions solicited from active members of the ASA, (3) testimony from attendees of publicly-held open forums at two national anesthesia meetings, (4) Internet commentary, and (5) Task Force opinion and interpretation. The survey

rate of return was 75% (n = 76 of 102) for the consultants, and 2326 surveys were received from active ASA members. Results of the surveys are reported in tables 5 and 6, and in the text of the Guidelines.

The consultants were asked to indicate which, if any, of the evidence linkages would change their clinical practices if the Guidelines were instituted. The rate of return was 35% (n = 36). The percent of responding Consultants expecting *no change* associated with each linkage were as follows: perianesthetic evaluation - 97%; aspiration prophylaxis- 83%; anesthetic care for labor and delivery - 89%; removal of retained placenta - 97%; anesthetic choices for cesarean delivery - 97%; postpartum tubal ligation - 97%; and management of complications - 94%. Ninety-seven percent of the respondents indicated that the Guidelines would have *no effect* on the amount of time spent on a typical case. One respondent indicated that there would be an increase of 5 minutes in the amount of time spent on a typical case with the implementation of these Guidelines.

Table 4. Meta-Analysis Summary

Linkages	N	Fisher Chi-square	p	Weighted Stouffer Zc	p	Effect Size	Mantel-Haenszel OR	CI	Heterogeneity Significance	Heterogeneity Effect Size
Early vs late epidural anesthetics										
Spontaneous delivery	5	-	-	-	-	-	1.03	0.94-1.13	-	0.838
Instrumented delivery	5	-	-	-	-	-	1.90	0.79-1.03	-	0.944
Cesarean delivery	5	-	-	-	-	-	1.03	0.93-1.15	-	0.941
Epidural local anesthetics with opioids vs equal doses of local anesthetics without opioids										
Analgesia (pain relief)	5	-	-	-	-	-	4.03	2.14-7.56	-	0.639
Spontaneous delivery	7	-	-	-	-	-	0.98	0.70-1.38	-	0.251
Hypotension	8	-	-	-	-	-	0.79	0.44-1.44	-	0.664
Pruritus	7	-	-	-	-	-	6.15	3.22-11.74	-	0.899
1 min Apgar	5	-	-	-	-	-	0.82	0.44-1.52	-	0.281
Continuous epidural infusion (CIE) of local anesthetics with opioids vs higher doses of local anesthetics without opioids										
Duration of labor	5	19.93	0.030	1.99	0.023	0.06	-	-	0.430	0.560
Spontaneous delivery	7	-	-	-	-	-	1.08	0.81-1.44	-	0.533
Motor block	6	-	-	-	-	-	0.29	0.21-0.40	-	0.011
1 min Apgar	6	-	-	-	-	-	0.94	0.60-1.47	-	0.919
Pencil-point vs cutting-bevel spinal needles										
Postdural puncture headache	5	-	-	-	-	-	0.34	0.18-0.63	-	0.272
Combined spinal-epidural (CSE) with opioids vs epidural local anesthetics with opioids										
Analgesia (pain relief)	5	-	-	-	-	-	0.42	0.24-0.73	-	0.056
Analgesia (time to onset)	5	56.35	0.001	-5.48	0.001	0.70	-	-	0.001	0.001
Maternal satisfaction with analgesia	5	-	-	-	-	-	0.97	0.58-2.26	-	0.056
Spontaneous delivery [1]	8	-	-	-	-	-	0.96	0.71-1.31	-	0.969
Hypotension	6	-	-	-	-	-	1.62	0.63-4.17	-	0.084
Motor block	5	-	-	-	-	-	2.99	1.59-5.60	-	0.236
Pruritus [1,2]	7	-	-	-	-	-	3.56	0.93-10.63	-	0.001
1 min Apgar	5	-	-	-	-	-	1.04	0.56-1.92	-	0.994

Patient-controlled epidural analgesia (PCEA) versus CIE										
Analgesic use	6	84.98	0.001	-8.61	0.001	0.47	-	-	0.109	0.001
Duration of labor 1st stage	6	22.41	0.033	-0.46	0.323	0.01	-	-	0.272	0.236
Duration of labor 2nd stage	7	21.24	0.096	0.34	0.367	0.01	-	-	0.496	0.525
Spontaneous delivery [1]	8	-	-	-	-	-	1.49	0.94-2.36	-	0.506
Motor block [2]	7	-	-	-	-	-	0.52	0.15-3.44	-	0.001
1 min Apgar	6	-	-	-	-	-	0.63	0.27-1.50	-	0.602
5 min Apgar	5	-	-	-	-	-	2.00	0.44-9.02	-	0.639
PCEA with background infusion versus PCEA										
Analgesia (pain relief)	5	-	-	-	-	-	3.33	1.87-5.92	-	0.399
Spontaneous delivery	5	-	-	-	-	-	0.83	0.41-1.69	-	0.935
Motor block	5	-	-	-	-	-	1.18	0.47-2.97	-	0.546
CSE vs epidural for cesarean delivery										
Hypotension	5	-	-	-	-	-	0.91	0.44-1.94	-	0.228
1 min Apgar	5	-	-	-	-	-	0.55	0.20-1.52	-	0.517
Fluid preloading vs coloading for cesarean delivery										
Hypotension	8	-	-	-	-	-	1.47	0.99-2.17	-	0.036
Hypotension (colloids only)	6	-	-	-	-	-	1.47	0.78-1.97	-	0.048
Intravenous ephedrine vs placebo for cesarean delivery										
Hypotension	5	-	-	-	-	-	0.31	0.53-0.65	-	0.623
Intravenous ephedrine vs phenylephrine for cesarean delivery										
Hypotension [1]	6	-	-	-	-	-	1.36	0.81-2.29	-	0.184
Umbilical artery pH [1]	6	57.47	0.001	-5.78	0.001	0.34	-	-	0.919	0.992
Neuraxial vs parenteral opioids for postoperative analgesia										
Nausea	9	-	-	-	-	-	1.13	0.57-2.22	-	0.053
Vomiting	6	-	-	-	-	-	1.02	0.37-2.81	-	0.314
Pruritus	9	-	-	-	-	-	6.23	3.32-11.68	-	0.585

[1] Double-blind studies only

[2] Dersimonian-Laird random effects odds ratio

OR = odds ratio; CIE = continuous infusion epidural; IV = intravenous; LA = local anesthetics; O = opioids; LA+O = local anesthetics with opioids; SD = standard deviation; CSE = combined spinal epidural; PCEA = patient-controlled epidural analgesia; GA = general anesthesia

Table 5. Consultant Survey Responses [********]

		Percent Responding to Each Item				
Perianesthetic Evaluation and Preparation:	N	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
1. Conduct a focused history and physical examination before providing anesthetic care	61	90.2*	6.6	1.6	1.6	0.0
2. A communication system should be in place to encourage early and ongoing contact between obstetric providers, anesthesiologists, and other members of the multidisciplinary team	61	91.8*	8.2	0.0	0.0	0.0
Intrapartum Platelet Count:						
3. The anesthesiologist's decision to order or require a platelet count should be individualized and based on a patient's history (*e.g.*, severe preeclampsia), physical examination and clinical signs	61	77.0*	21.3	0.0	1.6	0.0
Blood Type and Screen:						
4. A routine blood cross-match is not necessary for healthy and uncomplicated parturients for vaginal or operative delivery	60	56.7*	35.0	3.3	3.3	1.7
5. The decision whether to order or require a blood type and screen or cross-match should be based on maternal history, anticipated hemorrhagic complications (*e.g.*, placenta accreta in a patient with placenta previa and previous uterine surgery), and local institutional policies	60	75.0*	16.7	1.7	3.3	3.3
Perianesthetic Recording of Fetal Heart Rate:						
6. The fetal heart rate should be monitored by a qualified individual before and after administration of neuraxial analgesia for labor	60	81.7*	18.3	0.0	0.0	0.0
Aspiration Prevention:						
7. The oral intake of moderate amounts of clear liquids may be allowed for uncomplicated laboring patients	60	63.3*	35.0	0.0	1.7	0.0
8. The uncomplicated patient undergoing elective surgery (*e.g.*, scheduled cesarean delivery or postpartum tubal ligation) may have moderate amounts of clear liquids up to 2 h before induction of anesthesia	60	53.3*	30.0	6.7	8.3	1.7
9. The patient undergoing elective surgery (*e.g.*, scheduled cesarean delivery or postpartum tubal ligation) should undergo a fasting period for solids of 6 to 8 hours						

******** N = the number of consultants who responded to each item. An asterisk beside a percentage score indicates the median.

depending on the type of food ingested (*e.g.*, fat content)	60	76.7*	16.7	3.3	3.3	0.0
10. Laboring patients with additional risk factors for aspiration (*e.g.*, morbid obesity, diabetes, difficult airway) or patients at increased risk for operative delivery (*e.g.*, nonreassuring fetal heart rate pattern) may have further restrictions of oral intake, determined on a case-by-case basis	60	55.0*	33.3	5.0	6.7	0.0
11. Solid foods should be avoided in laboring patients	60	51.7*	26.7	15.0	6.7	0.0
12. Before surgical procedures (*e.g.*, cesarean delivery, postpartum tubal ligation), consider the timely administration of non-particulate antacids, H_2 receptor antagonists, and/or metoclopramide for aspiration prophylaxis	60	41.7	36.7*	13.3	6.7	1.7
Timing of Neuraxial Analgesia and Outcomes of Labor:						
13. Provide patients in early labor (*i.e.*, < 5 cm dilation) the option of neuraxial analgesia when this service is available	60	96.7*	3.3	0.0	0.0	0.0
14. Offer neuraxial analgesia on an individualized basis	60	71.7*	15.0	5.0	3.3	5.0
15. Do not withhold neuraxial analgesia on the basis of achieving an arbitrary cervical dilation	60	93.3*	5.0	0.0	1.7	0.0
Neuraxial Analgesia and Trial of Labor after Prior Cesarean Delivery:						
16. Offer neuraxial techniques to patients attempting vaginal birth after previous cesarean delivery	60	98.3*	1.7	0.0	0.0	0.0
17. For these patients, it is appropriate to consider early placement of a neuraxial catheter that can be used later for labor analgesia, or for anesthesia in the event of operative delivery	60	53.3*	26.7	13.3	3.3	3.3
Early Insertion of a Neuraxial (*i.e.*, Spinal or Epidural) Catheter for Complicated Parturients:						
18. Consider early insertion of a neuraxial catheter for obstetric (*e.g.*, twin gestation or preeclampsia) or anesthetic indications (*e.g.*, anticipated difficult airway or obesity) to reduce the need for general anesthesia if an emergent procedure becomes necessary	60	68.3*	28.3	1.7	0.0	1.7
Continuous Infusion Epidural (CIE) Analgesia:						
19. Continuous epidural infusion may be used for effective analgesia for labor and delivery	60	78.3*	20.0	1.7	0.0	0.0
20. When a continuous epidural infusion of local anesthetic is selected, an opioid may be added	60	91.7*	6.7	1.7	0.0	0.0
Analgesic Concentrations:						
21. Use dilute concentrations of local anesthetics						

with opioids to produce as little motor block as possible	60	78.3*	20.0	1.7	0.0	0.0
Single-Injection Spinal Opioids with or without Local Anesthetics:						
22. Single-injection spinal opioids with or without local anesthetics may be used to provide effective, although time-limited, analgesia for labor when spontaneous vaginal delivery is anticipated	60	41.7	45.0*	11.7	1.7	0.0
23. A local anesthetic may be added to a spinal opioid to increase duration and improve quality of analgesia	60	65.0*	33.3	1.7	0.0	0.0
Pencil-Point Spinal Needles:						
24. Use pencil-point spinal needles instead of cutting-bevel spinal needles to minimize the risk of postdural puncture headache	60	95.0*	1.7	3.3	0.0	0.0
Combined Spinal-Epidural Analgesia:						
25. If labor is expected to last longer than the analgesic effects of the spinal drugs chosen, or if there is a good possibility of operative delivery, then consider a catheter technique instead of a single injection technique	60	86.7*	8.3	3.3	0.0	1.7
26. Combined spinal-epidural techniques may be used to provide effective and rapid onset of analgesia for labor	60	78.3*	21.7	0.0	0.0	0.0
Patient-Controlled Epidural Analgesia (PCEA):						
27. Patient-controlled epidural analgesia may be used to provide an effective and flexible approach for the maintenance of labor analgesia	60	85.0*	15.0	0.0	0.0	0.0
28. The use of PCEA may be preferable to fixed-rate CIE for providing fewer anesthetic interventions and reduced dosages of local anesthetics	60	68.3*	21.7	10.0	0.0	0.0
29. Patient-controlled epidural analgesia may be used with or without a background infusion	60	28.3	33.3*	18.3	18.3	1.7
Anesthetic Techniques for Removal of Retained Placenta:						
30. If an epidural catheter is in place and the patient is hemodynamically stable, consider providing epidural anesthesia	60	83.3*	10.0	1.7	0.0	0.0
31. Assess hemodynamic status before administering neuraxial anesthesia	60	91.7*	8.3	0.0	0.0	0.0
32. Consider aspiration prophylaxis	60	46.7	36.7*	13.3	1.7	1.7
33. Titrate sedation/analgesia carefully due to the potential risks of respiratory depression and pulmonary aspiration during the immediate postpartum period	60	58.3*	38.3	1.7	1.7	0.0
34. In cases involving major maternal hemorrhage with hemodynamic instability, general						

anesthesia with an endotracheal tube may be considered in preference to neuraxial anesthesia	60	61.7*	33.3	5.0	0.0	0.0
Nitroglycerin for Uterine Relaxation:						
35. Nitroglycerin may be used as an alternative to terbutaline sulfate or general endotracheal anesthesia with halogenated agents for uterine relaxation during removal of retained placental tissue	60	73.3*	25.0	1.7	0.0	0.0
Equipment, Facilities, and Support Personnel:						
36. Equipment, facilities, and support personnel available in the labor and delivery operating suite should be comparable to those available in the main operating suite	60	93.3*	5.0	1.7	0.0	0.0
37. Resources for the treatment of potential complications (*e.g.*, failed intubation, inadequate analgesia, hypotension, respiratory depression, pruritus, vomiting) should also be available in the labor and delivery operating suite	60	96.7*	3.3	0.0	0.0	0.0
38. Appropriate equipment and personnel should be available to care for obstetric patients recovering from major neuraxial or GA	60	100*	0.0	0.0	0.0	0.0
General, Epidural, Spinal, or CSE Anesthesia:						
39. The decision to use a particular anesthetic technique for cesarean delivery should be individualized, based on anesthetic, obstetric or fetal risk factors (*e.g.*, elective *vs.* emergency), the preferences of the patient, and the judgment of the anesthesiologist	60	93.3*	6.7	0.0	0.0	0.0
40. Uterine displacement (usually left displacement) should be maintained until delivery regardless of the anesthetic technique used	60	60.0*	25.0	11.7	3.3	0.0
41. Consider selecting neuraxial techniques in preference to general anesthesia for most cesarean deliveries	60	91.7*	8.3	0.0	0.0	0.0
42. If spinal anesthesia is chosen, use pencil-point spinal needles instead of cutting-bevel spinal needles	60	95.0*	3.3	1.7	0.0	0.0
43. For urgent cesarean delivery, an indwelling epidural catheter may be used as an alternative to initiation of spinal anesthesia	59	83.0*	15.2	1.7	0.0	0.0
44. General anesthesia may be the most appropriate choice in some circumstances (*e.g.*, profound fetal bradycardia, ruptured uterus, severe hemorrhage, severe placental abruption)	60	80.0*	20.0	0.0	0.0	0.0
Intravenous Fluid Preloading:						
45. Intravenous fluid preloading may be used to						

reduce the frequency of maternal hypotension following spinal anesthesia for cesarean delivery	60	25.0	26.7*	25.0	18.3	5.0
46. Although fluid preloading reduces the frequency of maternal hypotension, do not delay the initiation of spinal anesthesia in order to administer a fixed volume of intravenous fluid	60	68.3*	26.7	5.0	0.0	0.0
Ephedrine or Phenylephrine:						
47. Intravenous ephedrine and phenylephrine both may be used for treating hypotension during neuraxial anesthesia	60	60.0*	33.3	3.3	1.7	1.7
Neuraxial Opioids for Postoperative Analgesia:						
48. For postoperative analgesia after neuraxial anesthesia for cesarean delivery, consider selecting neuraxial opioids rather than intermittent injections of parenteral opioids	60	85.0*	11.7	1.7	1.7	0.0
Postpartum Tubal Ligation:						
49. Before postpartum tubal ligation, the patient should have no oral intake of solid foods within 6 - 8 h of the surgery, depending on the type of food ingested (*e.g.*, fat content)	60	55.0*	28.3	6.7	10.0	0.0
50. Both the timing of the procedure and the decision to use a particular anesthetic technique (*i.e.*, neuraxial *vs.* general) should be individualized, based on anesthetic risk factors, obstetric risk factors (*e.g.*, blood loss), and patient preferences	60	78.3*	18.3	1.7	1.7	0.0
51. Consider selecting neuraxial techniques in preference to general anesthesia for most postpartum tubal ligations	60	73.3*	18.3	6.7	0.0	1.7
Management of Hemorrhagic Emergencies:						
52. Institutions providing obstetric care should have resources available to manage hemorrhagic emergencies	58	100.0*	0.0	0.0	0.0	0.0
53. Labor and delivery units should have personnel and equipment readily available to manage airway emergencies consistent with the ASA Practice Guidelines for Management of the Difficult Airway, to include a pulse oximeter and carbon dioxide detector	58	98.3*	1.7	0.0	0.0	0.0
54. Basic and advanced life-support equipment should be immediately available in the operative area of labor and delivery units	58	100.0*	0.0	0.0	0.0	0.0
55. If cardiac arrest occurs during labor and delivery, initiate standard resuscitative measures with accommodations for pregnancy such as left uterine displacement and preparing for delivery of the fetus	58	98.3*	1.7	0.0	0.0	0.0

Table 6. ASA Membership Survey Responses ††††††††

		Percent Responding to Each Item				
Perianesthetic Evaluation and Preparation:	N	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
1. Conduct a focused history and physical examination before providing anesthetic care	373	73.2*	21.4	3.2	1.3	0.8
2. A communication system should be in place to encourage early and ongoing contact between obstetric providers, anesthesiologists, and other members of the multidisciplinary team	373	81.0*	16.6	2.1	0.0	0.3
Intrapartum Platelet Count:						
3. The anesthesiologist's decision to order or require a platelet count should be individualized and based on a patient's history (*e.g.*, severe preeclampsia), physical examination and clinical signs	370	51.3*	29.7	5.9	10.8	2.2
Blood Type and Screen:						
4. A routine blood cross-match is not necessary for healthy and uncomplicated parturients for vaginal or operative delivery	367	38.4	38.7*	8.2	12.0	2.7
5. The decision whether to order or require a blood type and screen or cross-match should be based on maternal history, anticipated hemorrhagic complications (*e.g.*, placenta accreta in a patient with placenta previa and previous uterine surgery), and local institutional policies	367	49.3	33.0*	4.1	11.4	2.2
Perianesthetic Recording of Fetal Heart Rate:						
6. The fetal heart rate should be monitored by a qualified individual before and after administration of neuraxial analgesia for labor	366	68.3*	24.3	6.3	0.6	0.6
Aspiration Prevention:						
7. The oral intake of moderate amounts of clear liquids may be allowed for uncomplicated laboring patients	357	30.0	47.3*	9.5	10.4	2.8
8. The uncomplicated patient undergoing elective surgery (*e.g.*, scheduled cesarean delivery or postpartum tubal ligation) may have moderate amounts of clear liquids up to 2 h before induction of anesthesia	357	21.3	36.7*	9.0	25.5	7.6
9. The patient undergoing elective surgery (*e.g.*, scheduled cesarean delivery or postpartum tubal ligation) should undergo a fasting period for solids of 6 to 8 hours						

†††††††† N = the number of members who responded to each item. An asterisk beside a percentage score indicates the median.

depending on the type of food ingested (*e.g.*, fat content)	357	70.3*	27.7	0.3	0.8	0.8
10. Laboring patients with additional risk factors for aspiration (*e.g.*, morbid obesity, diabetes, difficult airway) or patients at increased risk for operative delivery (*e.g.*, nonreassuring fetal heart rate pattern) may have further restrictions of oral intake, determined on a case-by-case basis	357	56.9*	37.8	3.1	1.7	0.6
11. Solid foods should be avoided in laboring patients	357	63.0*	28.3	5.0	3.1	0.6
12. Before surgical procedures (*e.g.*, cesarean delivery, postpartum tubal ligation), consider the timely administration of non-particulate antacids, H_2 receptor antagonists, and/or metoclopramide for aspiration prophylaxis	355	43.9	38.6*	13.8	2.2	1.4
Timing of Neuraxial Analgesia and Outcomes of Labor:						
13. Provide patients in early labor (*i.e.*, < 5 cm dilation) the option of neuraxial analgesia when this service is available	354	62.7*	31.9	3.1	1.9	0.3
14. Offer neuraxial analgesia on an individualized basis	354	57.1*	28.8	8.2	4.8	1.1
15. Do not withhold neuraxial analgesia on the basis of achieving an arbitrary cervical dilation	354	66.1*	26.5	5.1	1.7	0.6
Neuraxial Analgesia and Trial of Labor after Prior Cesarean Delivery:						
16. Offer neuraxial techniques to patients attempting vaginal birth after previous cesarean delivery	354	64.1*	28.2	4.8	1.7	1.1
17. For these patients, it is appropriate to consider early placement of a neuraxial catheter that can be used later for labor analgesia, or for anesthesia in the event of operative delivery	354	53.4*	32.8	10.2	1.7	2.0
Early Insertion of a Neuraxial (*i.e.*, Spinal or Epidural) Catheter for Complicated Parturients:						
18. Consider early insertion of a neuraxial catheter for obstetric (*e.g.*, twin gestation or preeclampsia) or anesthetic indications (*e.g.*, anticipated difficult airway or obesity) to reduce the need for general anesthesia if an emergent procedure becomes necessary	352	56.2*	32.1	7.7	3.4	0.6
Continuous Infusion Epidural (CIE) Analgesia:						
19. Continuous epidural infusion may be used for effective analgesia for labor and delivery	351	82.6*	15.7	1.4	0.3	0.0
20. When a continuous epidural infusion of local anesthetic is selected, an opioid may be added	351	80.3*	17.1	2.0	0.6	0.0
Analgesic Concentrations:						
21. Use dilute concentrations of local anesthetics with opioids to produce as little motor block						

as possible	351	62.7*	30.2	5.1	1.4	0.6
Single-Injection Spinal Opioids with or without Local Anesthetics:						
22. Single-injection spinal opioids with or without local anesthetics may be used to provide effective, although time-limited, analgesia for labor when spontaneous vaginal delivery is anticipated	349	32.4	41.3*	17.5	7.7	1.2
23. A local anesthetic may be added to a spinal opioid to increase duration and improve quality of analgesia	349	46.7	39.5*	10.0	2.9	0.9
Pencil-Point Spinal Needles:						
24. Use pencil-point spinal needles instead of cutting-bevel spinal needles to minimize the risk of postdural puncture headache	349	81.1*	15.8	2.9	0.0	0.3
Combined Spinal-Epidural Analgesia:						
25. If labor is expected to last longer than the analgesic effects of the spinal drugs chosen, or if there is a good possibility of operative delivery, then consider a catheter technique instead of a single injection technique	348	75.0*	19.2	3.4	2.3	0.0
26. Combined spinal-epidural techniques may be used to provide effective and rapid onset of analgesia for labor	348	51.2*	33.3	11.8	2.0	1.7
Patient-Controlled Epidural Analgesia (PCEA):						
27. Patient-controlled epidural analgesia may be used to provide an effective and flexible approach for the maintenance of labor analgesia	344	69.2*	26.4	4.1	0.0	0.3
28. The use of PCEA may be preferable to fixed-rate CIE for providing fewer anesthetic interventions and reduced dosages of local anesthetics	344	52.6*	28.5	14.2	4.1	0.6
29. Patient-controlled epidural analgesia may be used with or without a background infusion	344	29.1	31.4*	15.1	22.1	2.3
Anesthetic Techniques for Removal of Retained Placenta:						
30. If an epidural catheter is in place and the patient is hemodynamically stable, consider providing epidural anesthesia	344	63.1*	34.0	2.3	0.3	0.3
31. Assess hemodynamic status before administering neuraxial anesthesia	344	81.1*	18.3	0.6	0.0	0.0
32. Consider aspiration prophylaxis	344	45.6	42.7*	9.3	1.2	1.2
33. Titrate sedation/analgesia carefully due to the potential risks of respiratory depression and pulmonary aspiration during the immediate postpartum period	344	57.3*	38.9	2.9	0.9	0.0
34. In cases involving major maternal hemorrhage with hemodynamic instability, general anesthesia with an endotracheal tube may be						

considered in preference to neuraxial anesthesia	344	64.2*	30.8	4.9	0.0	0.0
Nitroglycerin for Uterine Relaxation:						
35. Nitroglycerin may be used as an alternative to terbutaline sulfate or general endotracheal anesthesia with halogenated agents for uterine relaxation during removal of retained placental tissue	344	46.8	45.1*	7.6	0.3	0.3
Equipment, Facilities, and Support Personnel:						
36. Equipment, facilities, and support personnel available in the labor and delivery operating suite should be comparable to those available in the main operating suite	342	84.5*	13.4	1.7	0.3	0.0
37. Resources for the treatment of potential complications (*e.g.*, failed intubation, inadequate analgesia, hypotension, respiratory depression, pruritus, vomiting) should also be available in the labor and delivery operating suite	342	93.0*	6.4	0.0	0.3	0.3
38. Appropriate equipment and personnel should be available to care for obstetric patients recovering from major neuraxial or general anesthesia	342	92.4*	7.6	0.0	0.0	0.0
General, Epidural, Spinal, or CSE Anesthesia:						
39. The decision to use a particular anesthetic technique for cesarean delivery should be individualized, based on anesthetic, obstetric or fetal risk factors (*e.g.*, elective *vs.* emergency), the preferences of the patient, and the judgment of the anesthesiologist	340	87.3*	11.5	0.6	0.6	0.0
40. Uterine displacement (usually left displacement) should be maintained until delivery regardless of the anesthetic technique used	340	53.5*	34.1	9.1	3.2	0.0
41. Consider selecting neuraxial techniques in preference to general anesthesia for most cesarean deliveries	340	81.8*	17.3	0.6	0.3	0.0
42. If spinal anesthesia is chosen, use pencil-point spinal needles instead of cutting-bevel spinal needles	340	78.2*	18.8	2.3	0.3	0.3
43. For urgent cesarean delivery, an indwelling epidural catheter may be used as an alternative to initiation of spinal anesthesia	340	65.0*	27.9	4.7	1.8	0.6
44. General anesthesia may be the most appropriate choice in some circumstances (*e.g.*, profound fetal bradycardia, ruptured uterus, severe hemorrhage, severe placental abruption)	340	82.3*	16.5	0.6	0.3	0.3
Intravenous Fluid Preloading:						
45. Intravenous fluid preloading may be used to						

reduce the frequency of maternal hypotension following spinal anesthesia for cesarean delivery	339	41.3	41.9*	12.1	3.8	0.9
46. Although fluid preloading reduces the frequency of maternal hypotension, do not delay the initiation of spinal anesthesia in order to administer a fixed volume of intravenous fluid	339	42.5	35.7*	8.0	11.5	2.4
Ephedrine or Phenylephrine:						
47. Intravenous ephedrine and phenylephrine both may be used for treating hypotension during neuraxial anesthesia	339	67.9*	28.3	1.8	1.8	0.3
Neuraxial Opioids for Postoperative Analgesia:						
48. For postoperative analgesia after neuraxial anesthesia for cesarean delivery, consider selecting neuraxial opioids rather than intermittent injections of parenteral opioids	339	56.0*	33.6	8.3	0.9	1.2
Postpartum Tubal Ligation:						
49. Before postpartum tubal ligation, the patient should have no oral intake of solid foods within 6 - 8 h of the surgery, depending on the type of food ingested (*e.g.*, fat content)	337	73.6*	24.3	1.2	0.9	0.0
50. Both the timing of the procedure and the decision to use a particular anesthetic technique (*i.e.*, neuraxial *vs.* general) should be individualized, based on anesthetic risk factors, obstetric risk factors (*e.g.*, blood loss), and patient preferences	337	73.6*	22.8	2.1	1.5	0.0
51. Consider selecting neuraxial techniques in preference to general anesthesia for most postpartum tubal ligations	337	39.5	33.8*	20.2	5.6	0.9
Management of Hemorrhagic Emergencies:						
52. Institutions providing obstetric care should have resources available to manage hemorrhagic emergencies	331	95.9*	4.2	0.3	0.6	0.0
53. Labor and delivery units should have personnel and equipment readily available to manage airway emergencies consistent with the ASA Practice Guidelines for Management of the Difficult Airway, to include a pulse oximeter and carbon dioxide detector	331	94.0*	5.7	0.0	0.3	0.0
54. Basic and advanced life-support equipment should be immediately available in the operative area of labor and delivery units	331	94.3*	5.1	0.3	0.3	0.0
55. If cardiac arrest occurs during labor and delivery, initiate standard resuscitative measures with accommodations for pregnancy such as left uterine displacement and preparing for delivery of the fetus	331	92.1*	7.5	0.0	0.3	0.0