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**Notes:**

- The table above lists the contents of the document, organized under two main sections: **General Considerations** and **Regional Anesthesia and Analgesia**.

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**Abbreviations and Units**

- **Abbreviations:** This section likely contains common medical abbreviations used throughout the document.

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**Foreword**

- This section generally serves as an introduction, possibly discussing the importance or context of the document.

---

**Preface**

- This section typically provides an overview of the document’s purpose, scope, and any acknowledgments.

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**Editors and Contributors**

- This section credits the individuals responsible for the document, including editors and contributors who have contributed to its creation.

---

**General Considerations**

- This section focuses on foundational discussions relevant to obstetric care.

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**Regional Anesthesia and Analgesia**

- This section delves into specific techniques and considerations related to regional anesthesia and analgesia in obstetric settings.

---

**Communication in the Labor Room**

- This section might discuss strategies for optimizing communication during labor.

---

**Performing a Neuraxial Block for Analgesia/Anesthesia**

- This section could provide detailed procedural guidance on performing neuraxial blocks.

---

**Test Doses for Epidurals**

- This section might cover the use of test doses in epidural settings.

---

**Managing Practical Problems With Epidural Catheters**

- This section likely addresses common issues encountered with epidural catheters.

---

**Intrathecal Labor Analgesia**

- This section might discuss intrathecal analgesia for labor.

---

**Hazards of Labor Pain**

- This section might cover potential hazards and risks associated with labor pain.

---

**Managing Failed or Inadequate Epidural Analgesia for Labor**

- This section could provide strategies for managing failed or inadequate epidural analgesia.

---

**Extending Epidural Analgesia for Cesarean Section**

- This section might discuss extending epidural analgesia for cesarean section procedures.

---

**Managing Inadequate Regional Anesthesia for Cesarean Section**

- This section could address strategies for managing inadequate regional anesthesia during cesarean section.

---

**Pain Management After Cesarean Section**

- This section likely discusses pain management following cesarean section.

---

**Failure to Recover From a Regional Anesthesia Block**

- This section could cover the management of failure to recover from regional anesthesia.

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**Additional Notes:**

- The document appears to be structured to provide comprehensive guidance on anesthesia and analgesia in obstetric settings.

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ABBREVIATIONS

ACOG  American Congress of Obstetricians and Gynecologists
ASA  American Society of Anesthesiologists
BMI  Body Mass Index
CNS  Central nervous system
CSE  Combined spinal epidural
CSF  Cerebrospinal fluid
CT  Computed tomography
CTG  Cardiotocography
ECG  Electrocardiogram
EMG  Electromyogram
ER  Emergency room
GA  General anesthesia
GFR  Glomerular filtration rate
ICU  Intensive care unit
IM  Intramuscular
IV  Intravenous
MRI  Magnetic Resonance Imaging
NSAIDS  Nonsteroidal anti-inflammatory drugs
OR  Operating room
PET  Positron emission tomography
RA  Regional anesthesia
TSH  Thyroid stimulating hormone
units

μg  microgram
bpm  beats per minute
cm  centimeter
cmH2O  centimeter of water
g/L  gram per liter
iu  international units
kPa  kilopascals
L  liter
M  molarity
ml  milliliter
ml/hr  milliliter per hour
mEq/L  milliequivalents per liter
mg  milligram
mg/dL  milligram per deciliter
mg/kg  milligram per kilogram
ml/min  milliliter per minute
mm³  cubic millimeter
mmHg  millimeters of Mercury
mmol/L  millimoles per liter
mOsm/kg  milliosmoles per kilogram
N  newton
psi  pressure per square inch
u/h  units per hour
u/kg  units per kilogram
“To improve maternal health” is the stated aim of Millennium Development Goal #5. Major organizations around the world, including the World Federation of Societies of Anaesthesiologists (WFSA), have committed to achieving this goal and have signed on to the UN Secretary General’s Global Strategy for Women’s and Children’s Health. In support of this pledge, the WFSA has committed many thousands of dollars to developing educational materials and programmes for use in low-income regions of the world. Access to safe anesthesia for obstetrical care should be a basic human right.

In this new book, Drs Chan, Gatt and Sia, all prominent obstetrical anaesthesiologists, have brought together many contributions from experts in the field in order to provide a low-cost guidebook on obstetrical anesthesia. It is a practical book which contains a wealth of information on obstetrical and obstetric anesthesia issues. It is laid out very clearly and is easy to read. A copy should be kept at hand in all obstetrical units.

With the production of this book, the editors hope to be able to contribute to improved anesthesia care in obstetrics and thus to reducing maternal mortality or at least that portion of it related to anesthesia. I congratulate them on their efforts and look forward to hearing about improvements in maternal care.

Angela Enright OC, MB, FRCPC
President WFSA

One of the key missions of WHO is to improve maternal and child health; safe anesthesia for obstetric care is central to achieving this goal. This book will certainly make a significant contribution in this respect and should be a companion for all who practice obstetric anesthesia. I warmly congratulate the contributors for their efforts in bringing the practice of obstetric anesthesia to a higher level.

Professor Ivy Ng
GCEO, Singhealth Singapore
Preface

Frontline providers of obstetric anesthesia in many parts of the world sometimes find themselves in situations where limited knowledge, experience and resources may result in a life threat for the parturient and the fetus. Poor, irreversible outcomes may result, sometimes spelling the demise of both mother and baby.

This book is the culmination of the efforts of practitioners of obstetric anesthesia, principally from Asia and Oceania, and the fruit of the collective expertise of teachers of obstetric anesthesia. In particular, it aims to cater to the needs of healthcare providers in our midst. The contributors have painstakingly distilled much of their own experiences with great clarity. Apart from being a guide for the best practices in obstetric anesthesia and analgesia, this book is also a compilation of the invaluable professional ‘life lessons’ of many leaders of obstetric anesthesia in our region and beyond.

Throughout the book, great emphasis has been placed on teamwork, and the importance of organizing the appropriate approach and management of not only the normal parturient but the high-risk parturient is also highlighted. The prominent role of regional anesthesia is recognized, with much attention accorded to equip obstetric anesthesiologists with the latest knowledge, including the management of complications that may accrue. While general anesthesia is less frequently used, it is no less vital in urgent and life-threatening situations. Hence, no effort has been spared to highlight the controversies and complications arising from general anesthesia.

Of special note is the tendency of parturients in resource-poor regions to present in a very advanced state of decompensation; this is perhaps one of the greatest challenges for frontline providers who are tasked to manage these cases. The authors of the book have made a special effort to fill the gap in knowledge in this regard, and it is hope that this would help readers who may unfortunately find themselves in such situations more often than they desire.
By taking a very patient-centric approach, the editors hope that this book will allow providers to manage their patients more confidently and with an improved outcome. Certainly one mother or fetus lost is just one too many.

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Yoo Kuen Chan practices obstetric anesthesia and analgesia in the Department of Anaesthesiology, Faculty of Medicine, Kuala Lumpur, Malaysia. Her main mission is to improve care for parturients whether during normal or operative delivery. The strategy is to have providers realize the importance of better evaluation, good planning and focused commitment to an appropriate level of care especially in the high-risk parturient. This can only come through teamwork among all providers.

Stephen Gatt is the Head, Division of Anaesthesia & Intensive Care, Prince of Wales & Sydney Children’s Hospitals; he is also the Director of Anaesthesia, Prince of Wales Hospital and Senior Staff Specialist, Royal Hospital for Women. An Associate Professor in the Discipline of Anaesthesia, Critical Care & Emergency Medicine, University of New South Wales, he is also the President of the Obstetric Anaesthesia Society of Asia & Oceania (OASAO). He has lectured extensively on obstetric anesthesia internationally, stands on various editorial boards and has also published numerous scientific articles on this topic. He is the co-editor/author of two previous obstetric anesthesia textbooks. With a wide range of research interests, he tries to balance research and academic interests with a heavy and varied obstetric anesthesia practice. High quality, safe and pleasant care of mothers in labor and during delivery remains his primary priority.
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Understanding the Normal Pregnant Woman
by Eileen Lew

Background

The normal, healthy parturient undergoes changes in physiology, anatomy and drug handling that can impact anesthesia care in the peripartum period. These changes should be considered when formulating the management plan for delivery.

This chapter looks at those changes and their impact on the management of her pregnancy and delivery.

Physiological and Anatomical Changes

Changes in the Hematological System

- During pregnancy, maternal blood volume increases to ensure sufficient uteroplacental perfusion. This is due to increases in plasma volume (40–50%) and red cell volume (15–20%). As plasma volume increases disproportionately more than red cell volume; the ensuing dilutional effect causes a state of physiological anemia of pregnancy. These volume changes, mediated by the Renin-Angiotensin–Aldosterone Axis, progesterone and estrogen, reduce blood viscosity by 20% which helps maintain uteroplacental blood flow. The normal hematocrit in pregnancy is 32–34%.

- White cell volume also increases, with white cell counts up to 14,000/mm³, mediated by adrenocorticoid hormones.

- Platelet counts are usually in the lower spectrum of the normal range, due to increased destruction and hemodilution. However, clotting is not affected clinically.

- Pregnancy is a hypercoagulable state. It is characterized by increased levels of most clotting factors, such as Factors I, VII, VIII, IX, X and XII,
Understanding the Normal Pregnant Woman

- Decreased levels of natural anticoagulants and fibrinolytic activities, such as tissue plasminogen activator activity.
- Reduced procoagulant activity, as free and total protein S-antigen levels and activities decrease.

Hence, the parturient is at risk of developing thromboembolic diseases. Clotting activity increases the most at delivery, as the body adapts to reduce maternal blood loss. It can take up to 8 weeks postpartum for blood volume to revert to prepregnancy values, and generally 3–4 weeks postpartum for coagulation and fibrinolysis to return to prepregnancy levels.

Changes in the Cardiovascular System

- Maternal cardiac output increases by 30–40% from pregestation values, with the maximum increase achieved at 24 weeks.
- Table 1 lists the various cardiovascular changes that take place during pregnancy.

<table>
<thead>
<tr>
<th>Hemodynamic Parameters</th>
<th>Changes in Pregnancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac output</td>
<td>↑ 30–40%</td>
</tr>
<tr>
<td>Heart rate</td>
<td>↑ 15–20%</td>
</tr>
<tr>
<td>Stroke volume</td>
<td>↑ 20–30%</td>
</tr>
<tr>
<td>Mean arterial pressure</td>
<td>↓ 0–5%</td>
</tr>
<tr>
<td>Central venous pressure</td>
<td>unchanged</td>
</tr>
<tr>
<td>Systemic vascular resistance</td>
<td>↓ 20–30%</td>
</tr>
<tr>
<td>Left ventricular stroke work index</td>
<td>unchanged</td>
</tr>
<tr>
<td>Mean pulmonary artery pressure</td>
<td>unchanged</td>
</tr>
<tr>
<td>Pulmonary capillary wedge pressure</td>
<td>unchanged</td>
</tr>
</tbody>
</table>

Table 1: Cardiovascular changes during pregnancy

- The initial rise in cardiac output is due to an increase in stroke volume. By 28–32 weeks of gestation, however, an increase in heart rate of 10–15 beats per minute also contributes to the increased cardiac output.
- Mean arterial BP decreases during pregnancy, due to a reduction in systemic vascular resistance, modulated by estradiol-17β, progesterone, prostacyclin and nitric oxide.
• Cardiac output varies according to the position and size of the uterus. From 24 weeks of gestation, the significant size of the gravid uterus can cause aortocaval compression when the parturient is in the supine position. The subsequent reduction in venous return lowers cardiac output, causing symptomatic maternal hypotension. This is further aggravated in parturients with multiple pregnancies and polyhydramnios. Thus, when the parturient is in the supine position, maintain left uterine displacement by placing a wedge under the right hip or tilting the operating table left, particularly after a central neuraxial block has been administered.

• During labor, uterine contractions facilitate the release of placental-sequestered blood into the maternal circulation. This increases cardiac output by up to 50% of prelabor values. Immediately after delivery, the cardiac output may reach values of 80–100% above pregestation levels. Cardiac output returns to prelabor values 72 hours postpartum and decreases to prepregnancy levels 6–8 weeks after delivery. Parturients at risk of developing heart failure include those with

  ♦ pre-existing valvular and coronary heart diseases; they may decompensate during pregnancy and develop heart failure, and

  ♦ stenotic lesions, such as aortic and mitral stenosis; they are at a significantly higher risk of heart failure than those with regurgitant lesions. The risk is highest in the third trimester, during labor and immediately postpartum.

• **Uteroplacental blood flow** determines the rate of transport of oxygen and other nutrients to the developing fetus. At term, about 10% of cardiac output contributes to uterine blood flow, i.e. 700ml/min. The uteroplacental blood flow is directly related to uterine perfusion pressure and inversely related to vascular resistance:

\[
\text{Uteroplacental blood flow} = \frac{\text{Uterine arterial pressure} - \text{Uterine venous pressure}}{\text{Uterine vascular resistance}}
\]
• Uterine arterial pressure depends on systemic arterial pressure.
  ♦ Hypotension, hypovolemia from hemorrhage, aortocaval compression and sympathectomy from central neuraxial blocks decrease uterine arterial pressure and reduce uteroplacental blood flow.

• Increased uterine venous pressure also reduces uteroplacental perfusion.
  ♦ Uterine venous pressure may increase due to frequent uterine contractions during labor and oxytocin-induced uterine hypertonus.

**Changes in the Respiratory System**

• Minute ventilation increases by 20–50% at term, due largely to a 30–50% rise in tidal volume and, to a smaller extent, a 15% rise in respiratory rate.

• There is increased sensitivity of the medullary respiratory center to arterial blood carbon dioxide, mediated by progesterone.

• Arterial blood gas (ABG) in normal pregnancy is characterized by respiratory alkalosis with compensatory metabolic acidosis, due to increased renal excretion of bicarbonate (Table 2).

<table>
<thead>
<tr>
<th>ABG Measurement</th>
<th>Nonpregnant State</th>
<th>Pregnant State</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Third Trimester</td>
</tr>
<tr>
<td>pH</td>
<td>7.40</td>
<td>7.43</td>
</tr>
<tr>
<td>PaO2 (mmHg)</td>
<td>93</td>
<td>101–106</td>
</tr>
<tr>
<td>PaCO2 (mmHg)</td>
<td>37</td>
<td>32–35</td>
</tr>
<tr>
<td>Serum HCO3 (mEq/L)</td>
<td>23</td>
<td>17</td>
</tr>
</tbody>
</table>

Table 2: Changes in ABG during pregnancy

• Pregnancy has no effect on forced expiratory volume in 1 second (FEV1) and ratio of FEV1/forced vital capacity (FVC). However, functional residual capacity (FRC) decreases 15–20% at term, due mainly to reduced expiratory reserve volume (Table 3).
Managing a Parturient on Antithrombotic Therapy
by Yoo Kuen Chan

Background

Neuraxial blockade is increasingly being used for labor analgesia and anesthesia for cesarean section. Epidural analgesia is able to provide satisfactory analgesia for 80% of recipients compared to less than 30% of those receiving meperidine or entonox.

RA for cesarean section obviates the need for airway management which is 10 times more difficult in the obstetric population. The increasing use of RA for pregnant women is all the more significant given that they are 5–50 times more likely to develop venous thromboembolism and hence, to be on antithrombotic agents.

The use of antithrombotic agents increases the risk of spinal hematoma formation. The risk is unknown but current estimates range from 1:200,000 to 1:3000 depending on the populations studied. Spinal hematomas are rare entities, hence randomized controlled studies cannot be done to ascertain the risks. Most of the information comes from case reports, case series and databases. As there is limited specific information for the pregnant population in this regard, most guidelines are adapted from recommendations made for the nonobstetric general population.

This chapter discusses the use of antithrombotic agents, their risks and safe practice guidelines.

Use of Antithrombotic Agents

- Antithrombotic agents now include antiplatelet agents, anticoagulant agents, thrombolytic agents, as well as all other agents that are likely to increase the risk of bleeding or decrease the risk of coagulation such as herbal agents (not traditionally classified as belonging to the above categories).
Many parturients are on these agents for various reasons, such as:
- prophylaxis of thrombosis for prolonged bedrest required for critical medical condition;
- prophylaxis of thrombosis for cardiac diseases, especially for those with arrhythmias;
- part of treatment strategies for those with deep vein thrombosis (DVT) and pulmonary embolism; or
- having replaced metallic heart valves.

Patients using these agents at prophylactic doses must be differentiated from those using them at therapeutic (treatment) doses.

Prophylactic doses are typically lower doses (see Table 1).

<table>
<thead>
<tr>
<th>Generic</th>
<th>Max. prophylactic dose per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unfractionated heparin</td>
<td>Heparin (3 × 5000IU or aPTT in normal reference range)</td>
</tr>
<tr>
<td>Certoparin</td>
<td>1 × 3000 anti-Xa U s.c.</td>
</tr>
<tr>
<td>Daltsparin</td>
<td>1 × 5000 anti-Xa U s.c.</td>
</tr>
<tr>
<td>Enoxaparin</td>
<td>1 × 40 mg s.c.</td>
</tr>
<tr>
<td>Nadroparin</td>
<td>2850 anti-Xa U (0.3ml) or weight-adjusted, max. 5700 anti-Xa U s.c. (0.6ml)</td>
</tr>
<tr>
<td>Reviparin</td>
<td>1 × 1750 anti-Xa U s.c.</td>
</tr>
<tr>
<td>Tinzaparin</td>
<td>1 × 4500 anti-Xa U s.c.</td>
</tr>
<tr>
<td>Fondaparinux</td>
<td>1 × 2.5mg s.c.</td>
</tr>
<tr>
<td>Danaparoid</td>
<td>2 × 750 IU s.c.</td>
</tr>
<tr>
<td>Desirudin</td>
<td>2 × 15mg s.c.</td>
</tr>
<tr>
<td>Rivarozaban</td>
<td>1 × 10mg p.o.</td>
</tr>
<tr>
<td>Apixaban</td>
<td>2 × 2.5mg p.o.</td>
</tr>
<tr>
<td>Dabigatran</td>
<td>1 × 220mg (first dose 110mg); 1 × 150mg p.o. in the elderly patient &gt;75 years (first dose 75mg)</td>
</tr>
</tbody>
</table>

aPTT, activated partial thromboplastin time; p.o. orally; s.c. subcutaneously

Unlike those on treatment doses, those on prophylactic doses can temporarily halt drug use to create adequate intervals between drug administration and regional blockade for the safe performance of regional techniques.

However, sometimes those on recommended prophylactic doses of drugs may become therapeutically anticoagulated, as in the case of renal impairment.

The two main categories of agents used during pregnancy are heparin and warfarin.

Due to the risk of embryopathy, warfarin is avoided during the organogenesis stage of fetal development.

If not used properly, heparin may place the parturient at an increased risk of thrombosis compared with the use of warfarin, hence the use of heparin alone is not advocated for all stages of pregnancy.

The usual accepted arrangement is to use heparin during the first trimester, warfarin during the second and third trimesters up to 36 weeks gestation after which heparin is used to allow easier and better control in the event of bleeding during delivery.

**Balancing the Risks**

When a parturient presents with a known history of being on antithrombotic agents as prophylaxis, the risk of bleeding has to be balanced against the risk of performing RA with the hazard of incurring a spinal hematoma in the process.

There are no randomized controlled studies to ascertain the risks. Many national and international guidelines exist and these serve as good guides to decision-making (see Annex A).

The risks associated with the pharmacological action of the drugs must be weighed against the risk of not providing RA, such as the risk of the parturient experiencing inadequate analgesia, failed airway management and aspiration. Therefore, a good understanding of the pharmacological action of the drugs is necessary to make a rational decision.
♦ Using a more aggressive regimen increases the risk of bleeding; parturients who are on warfarin and have an international normalized ratio (INR) >3 are more likely to have bleeding than those with an INR <1.5.

♦ Parturients on a combination of antithrombotic agents, e.g. anticoagulant and antiplatelets agents, have an increased risk.

♦ Parturients on thrombolytic agents are at an even greater risk of bleeding and should not be given a regional blockade.

♦ There are newer agents which are Xa inhibitors like fondaparinux for which there is very limited experience.

♦ It is important to note that some elderly parturients may have had a regional blockade and are subsequently put on thrombolytic therapy for myocardial infarction (MI). These patients should be advised if they are at a higher risk of bleeding and need to be monitored for the risk of spinal hematoma formation.

♦ If the risk of failed airway management is high and RA is required, an intrathecal technique done with a fine needle is less likely to cause spinal hematoma than a regional technique like an epidural.

♦ Other factors like abnormal vertebral column, difficulty with needle placement and the use of a catheter when the patient is on antithrombotic therapy may put the parturient at a higher risk of developing a spinal hematoma.

### Timing of Thromboprophylaxis

- When parturients are on thromboprophylactic doses, it is possible to create intervals when drug action is minimal. This allows for safe administration of regional blockade or catheter removal when the risk of bleeding is decreased (see Table 2).

- If warfarin is used, it is stopped at 36 weeks before the onset of most deliveries and substituted with either low molecular weight heparin (LMWH) or unfractionated heparin which has a shorter duration of action.
<table>
<thead>
<tr>
<th>Drug Type</th>
<th>Time before puncture/catheter manipulation or removal</th>
<th>Time after puncture/catheter manipulation or removal</th>
<th>Laboratory tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unfractionated heparins (for prophylaxis, ≤15 000 IU per day)</td>
<td>4–6 h</td>
<td>1 h</td>
<td>Platelets during treatment for more than 5 days</td>
</tr>
<tr>
<td>Unfractionated heparins (for treatment)</td>
<td>i.v. 4–6 h, s.c. 8–12 h</td>
<td>1 h</td>
<td>aPTT, ACT, platelets</td>
</tr>
<tr>
<td>Low-molecular-weight heparins (for prophylaxis)</td>
<td>12 h</td>
<td>4 h</td>
<td>Platelets during treatment for more than 5 days</td>
</tr>
<tr>
<td>Low-molecular-weight heparins (for treatment)</td>
<td>24 h</td>
<td>4 h</td>
<td>Platelets during treatment for more than 5 days</td>
</tr>
<tr>
<td>Fondaparinux (for prophylaxis, 2.5mg per day)</td>
<td>36–42 h</td>
<td>6–12 h</td>
<td>(anti-Xa, standardized for specific agent)</td>
</tr>
<tr>
<td>Fondaparinux (for treatment)</td>
<td>24 h</td>
<td>4 h</td>
<td>aPTT, ACT, platelets</td>
</tr>
<tr>
<td>Low-molecular-weight heparins (for prophylaxis)</td>
<td>12 h</td>
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</tr>
<tr>
<td>Fondaparinux (for treatment)</td>
<td>24 h</td>
<td>4 h</td>
<td>aPTT, ACT, platelets</td>
</tr>
<tr>
<td>Apixaban (for prophylaxis, 2.5mg b.i.d.)</td>
<td>26–30 h</td>
<td>4–6 h</td>
<td>?</td>
</tr>
<tr>
<td>Dabigatran (for prophylaxis, 150–220mg)</td>
<td>Contraindicated according to the manufacturer</td>
<td>6 h</td>
<td>?</td>
</tr>
<tr>
<td>Coumarins</td>
<td>INR ≤1.4</td>
<td>After catheter removal</td>
<td>INR</td>
</tr>
<tr>
<td>Hirudins (lepirudin, desirudin)</td>
<td>8–10 h</td>
<td>2–4 h</td>
<td>aPTT, ECT</td>
</tr>
<tr>
<td>Argatroban(^b)</td>
<td>4 h</td>
<td>2 h</td>
<td>aPTT, ECT, ACT</td>
</tr>
<tr>
<td>Acetylsalicyclic Acid</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Clopidogrel</td>
<td>7 days</td>
<td>After catheter removal</td>
<td></td>
</tr>
<tr>
<td>Ticlopidine</td>
<td>10 days</td>
<td>After catheter removal</td>
<td></td>
</tr>
<tr>
<td>Prasugrel</td>
<td>7–10 days</td>
<td>6 h after catheter removal</td>
<td></td>
</tr>
<tr>
<td>Ticagrelor</td>
<td>5 days</td>
<td>6 h after catheter removal</td>
<td></td>
</tr>
<tr>
<td>Cilostazol</td>
<td>42 h</td>
<td>5 h after catheter removal</td>
<td></td>
</tr>
<tr>
<td>NSAIDs</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
</tbody>
</table>

ACT, activated clotting time; aPTT, activated thromboplastin time; b.i.d., twice daily; ECT, ecarin clotting time; INR, international normalized ratio; IU, international unit; i.v., intravenously; NSAIDs, non-steroidal anti-inflammatory drugs; s.c., subcutaneously; q.d., daily. \(^a\) All time intervals refer to patients with normal renal function. \(^b\) Prolonged time interval in patients with hepatic insufficiency.

Table 2: Recommended time intervals before and after neuraxial puncture or catheter removal. (Reproduced with permission from: Gogarten W, Vandermeulen E, Van Aken H, Kozek S, Llau JV, Samama CM et al. Regional anaesthesia and antithrombotic agents: recommendations of the European Society of Anaesthesiology. Eur J Anaesthesiol. 2010 Dec;27(12): 999–1015.)
Managing a Parturient on Antithrombotic Therapy

- **Heparin**, if used in prophylactic doses, allows for the creation of a ‘safe period’. If LMWH is used in prophylactic doses, RA can be safely administered 12 hours after the last dose of the drug.
  - Unfractionated heparin should be discontinued 4–6 hours before RA. After administering RA, the drug is again discontinued up to 24 hours postregional or postsurgery whichever is later.
- These safe periods may also be created using reversal agents.
  - For unfractionated heparin, protamine can be used at the ratio of 1mg protamine for every 100U of heparin administered intravenously.
  - For LMWH, however, protamine cannot be used as it only reverses the anti-IIa effect and not the anti-Xa effect.
  - For warfarin, intravenous vitamin K may be used or fresh frozen plasma (FFP) may be transfused if there is a need to
    - use the regional technique over other alternative nonregional options, or
    - produce a safe period for catheter removal.

**Alternative Options to Anesthesia and Analgesia**

- It must be remembered that removing the antithrombotic agent in parturients on therapeutic doses of the drug can become hazardous as it exposes the parturient to the risk of thrombosis. This is particularly so in parturients who have metallic cardiac values and are thus on antithrombotic agents.
- There are options to analgesia such as patient-controlled analgesia with the use of remifentanil. (See also ‘Hazards of Labor Pain and the Role of Nonneuraxial Analgesia’, p118).
- A combination of nonregional techniques can also be used to improve the analgesia obtained and to obviate the hazard of the parturient experiencing unnecessary pain during labor.
- GA is the main option for parturients who require cesarean delivery and are on therapeutic doses of antithrombotic agents.