Regional Anaesthesia for Caesarean Section

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DISCLOSURES

• No financial disclosures
• No industry affiliations
• No conflicts of interest
OBJECTIVES

1. Provide an overview of contemporary practice of spinal anaesthesia for caesarean section.
2. Discuss selected controversial areas.
OUTLINE:

• Intrathecal drug choice
• IV fluid management
• Lateral tilt
• Use of Vasopressors
OUTLINE:

• Intrathecal drug choice
Local Anaesthetic

Is Bupivacaine the local anaesthetic of choice?
Levobupivacaine  
Dextrobupivacaine
LEVOISOMERS

- Levobupivacaine
- Ropivacaine

- Lower toxicity
- Less motor block
Duration of motor block with intrathecal ropivacaine versus bupivacaine for caesarean section: a meta-analysis

R. Malhotra, a C. Johnstone, a S. Halpern, b J. Hunter, a A. Banerjee a

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bDepartment of Anesthesia, Sunnybrook Health Sciences Centre, Toronto, Canada

![Forest plot for duration of motor block](image)
Bupi™ Heavy
Bupivacaine Hydrochloride (as anhydrous) 0.5%
Dextrose 3%
Sterile hyperbaric solution
For Spinal Anaesthesia
Preservative free
4 ml Injection
Use of hyperbaric versus isobaric bupivacaine for spinal anaesthesia for caesarean section (Review)

Sia AI, Tan KH, Sng BL, Lim Y, Chan ESY, Siddiqui FJ
Hyperbaric vs Plain:

2013
• Faster onset
• Less conversion to GA

2016
• Faster onset
• GA & supplementation similar

2018
• Faster onset
• GA & supplementation similar
Spinal Ropivacaine for Cesarean Delivery: A Comparison of Hyperbaric and Plain Solutions

Kim S. Khaw, FRCA, Warwick D. Ngan Kee, MD, FANZCA, Mabel Wong, BHS, Floria Ng, BSc, and Anna Lee, PhD
Department of Anaesthesia and Intensive Care, The Chinese University of Hong Kong, Shatin, Hong Kong, China

- Less variability of block
- Postural manipulation
- Greater hypotension
What Dose of Bupivacaine?
What Dose of Bupivacaine?

Heavy Bupivacaine 0.5% (mL)

\[
\text{Weight (kg)} \times 0.2 + \text{Height (cm)} \times 0.3 + \text{Parity}^{1/2} - \text{Gestation (wk)/3} \times 0 + 2.5
\]

Acknowledgement: D. Fogarty
Local Anaesthetic + Additives

Bupivacaine
• Opioids
• Adrenaline
• Clonidine
• Neostigmine
• Ketamine
Adding adjunct agents

Possible advantages:
1. Decrease side effects
2. Increase efficacy
Adding adjunct agents

Possible disadvantages:

1. Drug error
2. Breach of sterility
3. Incompatibility
4. Cost
5. Safety (often “off-label”)
• Opioids
  • Adrenaline
  • Clonidine
  • Neostigmine
  • Ketamine

Only add an opioid
Local Anaesthetic Bupivacaine + Lipophilic Opioid Fentanyl
Perioperative Analgesia with Subarachnoid Fentanyl–
Bupivacaine for Cesarean Delivery

Catherine O. Hunt, M.D.,* J. Stephen Naulty, M.D.,† Angela M. Bader, M.D.,* Martha A. Hauch, M.D.,*
Jasmine V. Vartikar, M.D.,‡ Sanjay Datta, M.D.,§ Linda M. Hertwig, R.N.,∥ Gerard W. Osthelmer, M.D.**
Elective Caesareans ($n=56$)

Spinal Anaesthesia
Bupivacaine: weight based dose

Added Fentanyl (7 doses)

0 µg 2.5 µg 5 µg 6.25 µg 12.5 µg 25 µg 37.5 µg 50 µg

Intraoperative Opioid Supplementation

Nausea and Vomiting?
Intrathecal Fentanyl Is Superior to Intravenous Ondansetron for the Prevention of Perioperative Nausea During Cesarean Delivery with Spinal Anesthesia

Theodore R. Manullang, MD, Christopher M. Viscomi, MD, and Nathan L. Pace, MD, MStat

Department of Anesthesiology, University of Utah School of Medicine, Salt Lake City, Utah
Elective Spinal Caesareans \((n=30)\)

Hyperbaric Bupivacaine 12 mg

- IV Ondansetron 4 mg
- IT Fentanyl 15 µg

- FENTANYL: Less intraoperative pain
- FENTANYL: Less intraoperative nausea

Adding an opioid reduces visceral stimulation

Morphine

- 100 - 200 µg
- Preservative-free
- Postop analgesia
Fentanyl 10 – 15 µg
+ Morphine 100 – 200 µg

ALTERNATIVES
• Diamorphine
• Hydromorphone
Pain relief after caesarean section

Dr N Lucas, Dr E Pickering, Dr F Plaat

**Proposed standard or target for best practice**

- > 95% women to be satisfied with analgesia on day 1 post caesarean section.
- 100% women received subarachnoid or epidural opioids if CS performed by regional anaesthesia.
- Unless contraindicated, 100% women to be prescribed regular NSAIDs.
Local Anaesthetic + Additives

Bupivacaine
Urgent Cases:

- No touch technique
- Limit attempts
- Simultaneous preparation for GA
- Local anaesthetic only
OUTLINE:

• Intrathecal drug choice

• IV fluid management
Intravenous fluids

Many Uncertainties

Crystalloid vs Colloid

Prehydration vs Cohydration
# IV Fluid: Type and Timing

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<tr>
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<th>Prehydration</th>
<th>Cohydration</th>
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<td>Crystalloid</td>
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<td>+</td>
</tr>
<tr>
<td>Colloid</td>
<td>+</td>
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</table>
Preload or coload for spinal anesthesia for elective Cesarean delivery: a meta-analysis

Pré-charge ou co-charge lors de rachianesthésie pour un accouchement non urgent par césarienne: une méta-analyse

Arnab Banerjee, MD · Renato M. Stocche, MD, PhD · Pamela Angle, MD · Stephen H. Halpern, MD
Prevention of Hypotension during Spinal Anesthesia for Cesarean Delivery

An Effective Technique Using Combination Phenylephrine Infusion and Crystalloid Cobydration

112 Elective CS

No Prehydration

Spinal Anaesthesia

Titrated Phenylephrine Infusion

Rapid Crystalloid Co-hydration or Maintenance IV Fluid

Volume augmentation effect or Faster vasopressor distribution
Recommendation:

- Crystalloid: cohydration
- Colloid: prehydration or cohydration

- Don't rely on IV fluids
- Don't delay for IV fluids
OUTLINE:

- Intrathecal drug choice
- IV fluid management
- Lateral tilt
Lateral tilt
Lateral tilt

Universally used, but:

• Optimal amount of tilt controversial.
• Usually overestimated.
TIME AND LATERAL TILT AT CAESAREAN SECTION

J. S. CRAWFORD, MARILYN BURTON AND P. DAVIES

SUMMARY

Suggested 15 degrees
Comparison of measured and estimated angles of table tilt at Caesarean section

S. J. Jones¹, S. M. Kinsella² and F. A. Donald¹*
Lateral Tilt

Fig 1 Measured and estimated degrees of table tilt at Caesarean section.

Left Lateral Table Tilt for Elective Cesarean Delivery under Spinal Anesthesia Has No Effect on Neonatal Acid–Base Status

A Randomized Controlled Trial

100 elective CS

Spinal anaesthesia

Titrated phenylephrine infusion

Supine

or

15 degrees left tilt

Primary Outcome: UA Base Excess

SECONDARY OUTCOMES:

• Phenylephrine dose greater with no tilt
• Cardiac output lower with no tilt
Don’t abandon yet
• High risk cases
• Individual response may vary

No need to ensure 15 degrees
• Can omit if not tolerated
OUTLINE:

- Intrathecal drug choice
- IV fluid management
- Lateral tilt
- Use of Vasopressors
Background

Physiology of spinal hypotension
**Physiology**

The Past…

- Vasodilation
- Aortocaval Compression
  - ↓ Venous Return
  - ↓ Cardiac Filling
  - ↓ Cardiac Output
  - Hypotension
Physiology

The Past...
MECHANICAL METHODS

Maintenance of cardiac filling:

• Lateral tilt
• IV fluids
• Leg compression
Mechanical Methods Of Maintaining Cardiac Filling

Physiology

Mechanical Methods

B. Vasodilation
C. Aortocaval Compression

- ↓ Venous Return
- ↓ Cardiac Filling
- ↓ Cardiac Output

Hypotension

Not Very Effective
Continuous Invasive Blood Pressure and Cardiac Output Monitoring during Cesarean Delivery

A Randomized, Double-blind Comparison of Low-dose versus High-dose Spinal Anesthesia with Intravenous Phenylephrine or Placebo Infusion

Eldrid Langesæter, M.D.*, Leiv Arne Rosseland, M.D., Ph.D.*, Audun Stubhaug, M.D., Ph.D.†

The Dose-Dependent Effects of Phenylephrine for Elective Cesarean Delivery Under Spinal Anesthesia

Adrienne Stewart, FRCA, * Roshan Fernando, FRCA, * Sarah McDonald, FRCA, †
Rachel Hignett, FRCA, † Tanya Jones, FRCA, § and Malachy Columb, FRCA ||
Cardiac Output (L/min)

Time after spinal anesthesia (sec)

(No prophylactic vasopressor)

Modified from: Langesaeter E et al. *Anesthesiology* 2008; 109: 856-63
Dependence on Sympathetic Vasodilation

Arteriolar Vasodilation

↓ Systemic Vascular Resistance

Hypotension
Dependence on Sympathetic Vasodilation

Arteriolar Vasodilation

↓ Systemic Vascular Resistance

Hypotension
Phenylephrine
How best to use phenylephrine?

- Method of administration
- Timing of administration
Methods....

**Bolus vs Infusion**

- Both effective
- Intermittent bolus simple
- Infusion convenient
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 Cesarean Delivery

Sahar M. Siddik-Sayyid, MD, FRCA, Samar K. Taha, MD, Ghassan E. Kanazi, MD, and Marie T. Aouad, MD

INFUSIONS

- Less hypotension
- More hypertension
- Less nausea/vomiting
- Fewer physician interventions
BOLUSES: Whenever any decrease in BP

- Better early BP control
- Lower vasopressor total dose
- No clinical advantage to infusions
Prevention vs Treatment

Timing....

Most effective management:

• Start **infusion** immediately after intrathecal injection
• Give **boluses** as soon as BP falls
Alternative Vasopressors?
The Ideal...

- Fast
- Effective
- Cheap
- Titratable
- No bradycardia
- Preserve cardiac output
- Preserve uterine blood flow
The Ideal Vasopressor?

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<th>Phenylephrine</th>
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<td>++ +</td>
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<tr>
<td>Ideal Alternative</td>
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Comparison of Metaraminol and Ephedrine Infusions for Maintaining Arterial Pressure during Spinal Anesthesia for Elective Cesarean Section

Bae B. Lee, M.B.B.S., F.A.N.Z.C.A.‡
A randomised double-blind trial of phenylephrine and metaraminol infusions for prevention of hypotension during spinal and combined spinal–epidural anaesthesia for elective caesarean section


1 Clinical Associate Professor, School of Medicine and Pharmacology, 2 Clinical Associate Professor, School of Women’s and Infants Health, The University of Western Australia, Perth, Australia
4 Consultant Anaesthetist, St Michael’s Hospital, Bristol, UK
5 Consultant Anaesthetist, Rockingham General Hospital, Rockingham, Australia
6 Statistician, Biostatistics and Research Design Unit, Women and Infants Research Foundation, Perth, Australia
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<td>Phenylephrine</td>
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<tr>
<td>Norepinephrine (Noradrenaline)</td>
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<td>+</td>
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Noradrenaline/Norepinephrine

- Readily available, old drug.
- Familiar to anaesthesiologists.
- Easy to titrate.
- Preferred in ICU (better cardiac output).
- More available globally.
- Cheaper!
Randomized Double-blinded Comparison of Norepinephrine and Phenylephrine for Maintenance of Blood Pressure during Spinal Anesthesia for Cesarean Delivery

Shara W. Y. Lee, B.Sc.(Hons.), M.Sc., Ph.D., Flavia F. Ng, R.N., B.A.Sc.,
Perpetua E. Tan, B.Sc., M.Phil., Kim S. Khaw, M.B.B.S., M.D., F.R.C.A., F.H.K.A.M.
Elective Spinal CS ($n=104$)

Computer-controlled infusion

Phenylephrine
100 mcg/ml

Norepinephrine
5 mcg/ml

Ngan Kee WD et al. *Anesthesiology* 2015;122:736-45
Systolic Blood Pressure

Similar between groups

$P = 0.005$

Ngan Kee WD et al. Anesthesiology 2015;122:736-45
Heart Rate

Greater with Norepinephrine

$P = 0.002$

Ngan Kee WD et al. *Anesthesiology* 2015;122:736-45
Cardiac Output

Greater with Norepinephrine

Ngan Kee WD et al. Anesthesiology 2015;122:736-45
Prophylactic Norepinephrine Infusion for Preventing Hypotension During Spinal Anesthesia for Cesarean Delivery

Warwick D. Ngan Kee, MD, FANZCA, FHKCA,* Shara W.Y. Lee, PhD,† Floria F. Ng, RN, BASc,* and Kim S. Khaw, MD, FRCA, FHKCA*
Prophylactic Norepinephrine Infusion

Ngan Kee WD et al. Anesth Analg 2017
• Exclusive use of Norepinephrine over 12 months
• Elective and emergency CS
• Fetal acidosis: 3-4%
• No ischaemic complications
Norepinephrine Intermittent Intravenous Boluses to Prevent Hypotension During Spinal Anesthesia for Cesarean Delivery: A Sequential Allocation Dose-Finding Study

Desire N. Onwochei, MBBS BSc (Hons), FRCA,* Warwick D. Ngan Kee, MBChB, MD, FANZCA, FHKCA,† Lillia Fung, MD, FRCPC,* Kristi Downey, MSc,* Xiang Y. Ye, MSc,‡ and Jose C. A. Carvalho, MD, PhD, FANZCA, FRCPC*
- Intermittent boluses to prevent hypotension
- $ED_{90} = 5.49 \mu g$ (95% CI 5.0-6.6)

Onwochei et al. *Anesth Analg* 2017; 125:212-8
A Random-allocation Graded Dose–Response Study of Norepinephrine and Phenylephrine for Treating Hypotension during Spinal Anesthesia for Cesarean Delivery

Elective Spinal CS ($n=180$)

1$^{st}$ Hypotension

- Phenylephrine
  - 60 to 200 µg
- Norepinephrine
  - 4 to 12 µg

Restoration of BP to baseline (%)
Phenylephrine 100 µg = Norepinephrine 7.6 µg
The Ideal…

Further work required…
Key Points
Key Points

1. Heavy bupivacaine + opioid still best
Key Points

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2. IV prehydration helps (a little)
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2. IV prehydration helps (a little)
3. Lateral tilt not mandatory (but recommended)
Key Points

1. Heavy bupivacaine + opioid still best
2. IV prehydration helps (a little)
3. Lateral tilt not mandatory  
   (but recommended)
4. Use vasopressors proactively
1. Heavy bupivacaine + opioid still best
2. IV prehydration helps (a little)
3. Lateral tilt not mandatory
   (but recommended)
4. Use vasopressors proactively
5. Consider Noradrenaline…
   (Phenylephine 100 µg = Noradrenaline 7.6 µg)
Regional Anaesthesia for Caesarean Section

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