Regional Anaesthesia for Caesarean Section
"The Best Recipe"

Warwick D. Ngan Kee
Dept of Anaesthesia & Intensive Care
The Chinese University of Hong Kong
What I will **not** do....

- Magic recipes
- One shoe to fit all
What I will do....

• Discuss selected controversial issues
• Practical recommendations
BASICS

- Preassessment
- Premedication
- Consent
- Monitoring
- Vascular access
- 1-2-3
- Postop analgesia
OUTLINE

- Techniques
- Drug Choice
- Drug Dose
- Fluids
- Vasopressors
- Oxygen
<table>
<thead>
<tr>
<th>Options</th>
<th>Epidural</th>
<th>Spinal</th>
<th>CSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>✗</td>
<td>✓✓</td>
<td>✓</td>
</tr>
<tr>
<td>Simplicity</td>
<td>✓</td>
<td>✓✓</td>
<td>✗</td>
</tr>
<tr>
<td>Drug Dose</td>
<td>✗</td>
<td>✓</td>
<td>✓✓</td>
</tr>
<tr>
<td>Block Quality</td>
<td>✗</td>
<td>✓✓</td>
<td>✓✓</td>
</tr>
<tr>
<td>Hypotension</td>
<td>✓✓</td>
<td>✗</td>
<td>✓</td>
</tr>
<tr>
<td>Duration</td>
<td>✓</td>
<td>✗</td>
<td>✓</td>
</tr>
<tr>
<td>Recovery</td>
<td>✗</td>
<td>✓✓</td>
<td>✓✓</td>
</tr>
</tbody>
</table>
OUTLINE

• Techniques
• Drug Choice
Local Anaesthetic
Bupivacaine
Use of hyperbaric versus isobaric bupivacaine for spinal anaesthesia for caesarean section (Review)

Sia AT, Tan KH, Sng BL, Lim Y, Chan ESY, Siddiqui FJ
Onset Speed (time to T5 block)

Comparison: 1 Hyperbaric bupivacaine versus isobaric bupivacaine
Outcome: 6 Time to dermatomal block T4 block (mins)

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Hyperbaric</th>
<th>Isobaric</th>
<th>Mean Difference</th>
<th>Weight</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean(SD)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Richardson 1998</td>
<td>15</td>
<td>3 (1)</td>
<td></td>
<td>43.4%</td>
<td>-1.00 [-2.13, 0.13]</td>
</tr>
<tr>
<td>Vichitejpaisal 1992</td>
<td>50</td>
<td>5.4 (2.6)</td>
<td></td>
<td>56.6%</td>
<td>-1.10 [-2.09, -0.11]</td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td><strong>65</strong></td>
<td><strong>63</strong></td>
<td></td>
<td><strong>100.0%</strong></td>
<td><strong>-1.06 [-1.80, -0.31]</strong></td>
</tr>
</tbody>
</table>

Heterogeneity: Chi² = 0.02, df = 1 (P = 0.90); I² = 0.0%
Test for overall effect: Z = 2.78 (P = 0.0054)
Test for subgroup differences: Not applicable
Conversion to General Anaesthesia

Sia et al. (Cochrane Review)
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
Coefficient of variation:

- Hyperbaric: 17.7%
- Plain: 21.9%

Additives

- 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”)
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 Spinal Caesarean \((n=56)\) \n\[
\text{Height-adjusted IT Bupivacaine}
\]
\[
\text{Added Fentanyl 0-50 µg}
\]
- Quality of Block
- Intraoperative Analgesic Requirement

Intraoperative Opioid Supplementation

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 Caesarean (n=30)

Hyperbaric Bupivacaine 12 mg

- IV Ondansetron 4 mg
- IT Fentanyl 15 µg

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

OUTLINE

• Techniques
• Drug Choice
• Drug Dose
Dose required for adequate spinal block

Single shot spinal
Ultra-low dose combined spinal-epidural anesthesia with intrathecal bupivacaine 3.75 mg for cesarean delivery: a randomized controlled trial

W. H. L. Teoh, E. Thomas, H. M. Tan
Department of Women’s Anesthesia, KK Women’s and Children’s Hospital, Singapore

Low-Dose Bupivacaine-Fentanyl Spinal Anesthesia for Cesarean Delivery

Bruce Ben-David, M.D., Gabriella Miller, M.D., Rahel Gavriel M.D., and Alexander Gurevitch, M.D.

Combined low-dose spinal-epidural anesthesia versus single-shot spinal anesthesia for elective cesarean delivery

Department of Anesthesiology and Pain Medicine, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Korea
Efficacy of low-dose bupivacaine in spinal anaesthesia for Caesarean delivery: systematic review and meta-analysis

C. Arzola\textsuperscript{1*} and P. M. Wieczorek\textsuperscript{2}

1 Department of Anesthesia and Pain Management, Mount Sinai Hospital and University of Toronto, 600 University Avenue, Room 1514, Toronto, ON, Canada M5G 1X5
2 SMBD-Jewish General Hospital and McGill University, 3755 Côte Ste-Catherine Road, Room A335, Montreal, QC, Canada H3T 1E2
* Corresponding author. E-mail: carzola@mtsinoi.on.ca

Low Dose
(\leq 8\,\text{mg bupivacaine})

Conventional Dose
(> 8\,\text{mg bupivacaine})
HYPOTENSION: Low Dose vs Conventional Dose

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Low dose</th>
<th>Conventional dose</th>
<th>Risk ratio M-H, Random, 95% CI</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choi and colleagues-a(^{21})</td>
<td>9</td>
<td>20</td>
<td>0.86 (0.49, 1.51)</td>
<td>2000</td>
</tr>
<tr>
<td>Choi and colleagues-b(^{21})</td>
<td>6</td>
<td>20</td>
<td>0.75 (0.35, 1.62)</td>
<td>2000</td>
</tr>
<tr>
<td>Kiran and Singal(^{20})</td>
<td>4</td>
<td>20</td>
<td>0.44 (0.17, 1.14)</td>
<td>2002</td>
</tr>
<tr>
<td>Rivero and colleagues(^{26})</td>
<td>35</td>
<td>51</td>
<td>0.95 (0.74, 1.21)</td>
<td>2004</td>
</tr>
<tr>
<td>Nagata and colleagues(^{31})</td>
<td>7</td>
<td>19</td>
<td>0.43 (0.26, 0.80)</td>
<td>2004</td>
</tr>
<tr>
<td>Guasch and colleagues(^{37})</td>
<td>4</td>
<td>21</td>
<td>0.57 (0.20, 1.66)</td>
<td>2005</td>
</tr>
<tr>
<td>Bryson and colleagues(^{34})</td>
<td>20</td>
<td>27</td>
<td>0.97 (0.71, 1.33)</td>
<td>2007</td>
</tr>
<tr>
<td>Leo and colleagues(^{39})</td>
<td>17</td>
<td>40</td>
<td>0.61 (0.38, 0.96)</td>
<td>2009</td>
</tr>
<tr>
<td>Mebazaa and colleagues(^{33})</td>
<td>27</td>
<td>40</td>
<td>0.77 (0.60, 0.99)</td>
<td>2010</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>258</td>
<td>298</td>
<td>0.78 (0.65, 0.93)</td>
<td></td>
</tr>
</tbody>
</table>

Total events: 129, 184
Heterogeneity: \( I^2 = 0.02; \chi^2 = 11.21, df=8 (P=0.19); I^2 = 29\%
Test for overall effect: Z = 2.83 (\(P = 0.005\))

NAUSEA/VOMITING: Low Dose vs Conventional Dose

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Low dose</th>
<th>Conventional dose</th>
<th>Risk ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Events</td>
<td>Total</td>
<td>Events</td>
</tr>
<tr>
<td>Choi and colleagues-a</td>
<td>7</td>
<td>20</td>
<td>19</td>
</tr>
<tr>
<td>Choi and colleagues-B</td>
<td>2</td>
<td>20</td>
<td>6</td>
</tr>
<tr>
<td>Kiran and Singa</td>
<td>3</td>
<td>20</td>
<td>5</td>
</tr>
<tr>
<td>Rivero and colleagues</td>
<td>1</td>
<td>51</td>
<td>5</td>
</tr>
<tr>
<td>Ginosar and colleagues</td>
<td>0</td>
<td>18</td>
<td>4</td>
</tr>
<tr>
<td>Negata and colleagues</td>
<td>15</td>
<td>19</td>
<td>11</td>
</tr>
<tr>
<td>Carvalho and colleagues</td>
<td>5</td>
<td>25</td>
<td>5</td>
</tr>
<tr>
<td>Guasch and colleagues</td>
<td>5</td>
<td>21</td>
<td>7</td>
</tr>
<tr>
<td>Bryson and colleagues</td>
<td>9</td>
<td>27</td>
<td>10</td>
</tr>
<tr>
<td>Leo and colleagues</td>
<td>7</td>
<td>40</td>
<td>2</td>
</tr>
<tr>
<td>Mebazaa and colleagues</td>
<td>9</td>
<td>40</td>
<td>21</td>
</tr>
</tbody>
</table>

Total (95% CI) | 301 | 345 | 100.0% | 0.71 (0.55, 0.93)

Total events | 63 | 95

Heterogeneity: X²=10.58; df=10 (P=0.59); I²=6%
Test for overall effect: Z=2.51 (P<0.01)

SUPPLEMENTATION: Low Dose vs Conventional Dose

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Low dose</th>
<th>Conventional dose</th>
<th>Risk ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Events</td>
<td>Total</td>
<td>Total</td>
</tr>
<tr>
<td>Choi and colleagues-a</td>
<td>7</td>
<td>20</td>
<td>4</td>
</tr>
<tr>
<td>Choi and colleagues-b</td>
<td>0</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>Klian and Singal</td>
<td>5</td>
<td>20</td>
<td>5</td>
</tr>
<tr>
<td>Gincsar and colleagues</td>
<td>11</td>
<td>18</td>
<td>3</td>
</tr>
<tr>
<td>Rivero and colleagues</td>
<td>3</td>
<td>51</td>
<td>0</td>
</tr>
<tr>
<td>Nagata and colleagues</td>
<td>0</td>
<td>19</td>
<td>0</td>
</tr>
<tr>
<td>Guasch and colleagues</td>
<td>3</td>
<td>21</td>
<td>0</td>
</tr>
<tr>
<td>Kimoto and colleagues</td>
<td>10</td>
<td>18</td>
<td>1</td>
</tr>
<tr>
<td>Carvalho and colleagues</td>
<td>16</td>
<td>25</td>
<td>3</td>
</tr>
<tr>
<td>Bryson and colleagues</td>
<td>5</td>
<td>27</td>
<td>1</td>
</tr>
<tr>
<td>Leo and colleagues</td>
<td>12</td>
<td>40</td>
<td>3</td>
</tr>
<tr>
<td>Mebazaa and colleagues</td>
<td>1</td>
<td>40</td>
<td>0</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>317</td>
<td>376</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Total events: 73

Heterogeneity: $I^2=0.00, \chi^2=6.20, df=9 (P=0.72); I^2=0.00$
Test for overall effect: $Z=5.70 (P<0.00001)$

“Low dose bupivacaine….compromises anaesthetic efficacy…despite the benefit of lower maternal side effects”

“Lower anaesthetic doses cannot be recommended unless an epidural catheter is in place (CSE)…”
Recommendation:

- Use smallest dose of LA for circumstances
- Add opioid (fentanyl/sufentanil)
- CSE: useful for high-risk or long surgery
OUTLINE

• Techniques
• Drug Choice
• Drug Dose
Intravenous fluids

Uncertainties:

• Why?
• What?
• When?
• How much?
• How fast?
<table>
<thead>
<tr>
<th></th>
<th>Prehydration</th>
<th>Cohydration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crystalloid</td>
<td>−</td>
<td>(+)</td>
</tr>
<tr>
<td>Colloid</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>
Effects of Crystalloid and Colloid Preload on Blood Volume in the Parturient Undergoing Spinal Anesthesia for Elective Cesarean section

Hiroshi Ueyama, M.D.,* Yan-Ling He, Ph.D.,† Hironobu Tanigami, M.D.,* Takashi Mashimo, M.D.,‡ Ikuto Yoshiya, M.D.
Elective Caesareans ($n=36$)

- Lactated Ringers 1.5 L
- HES 0.5 L
- HES 1.0 L

- Hypotension
- Blood volume & cardiac output

Adapted from Ueyama H et al. Anesthesiology 1999; 91:1561-6
Colloid Prehydration:

DISADVANTAGES

• Cost.
• Effects on coagulation.
• Fluid overload.
• Hemodilution.
• Allergic reactions.
Recommendation:

• Crystalloid: cohydration
• Colloid: prehydration or cohydration
• Don't rely on IV fluids
• Don't delay for IV fluids
OUTLINE

• Techniques
• Drug Choice
• Drug Dose
• Fluids
Phenylephrine
FORUM
Prevention and management of hypotension during spinal anaesthesia for elective Caesarean section: a survey of practice

S. M. Burns, C. M. Cowan and R. G. Wilkes

1 Specialist Registrar in Anaesthesia and 2 Consultant Anaesthetist, Liverpool Women's Hospital, Crown Street, Liverpool L8 7SS, UK
Vasopressors at Caesarean section

- Ephedrine: 95.2% (1999), 42% (2007)
- Phenylephrine: 0.4% (1999), 51% (2007)
- Other: 4.5% (1999), 6% (2007)
Why use phenylephrine?

- *Phenylephrine is more effective*
- *Ephedrine causes fetal acidosis*
Ephedrine depresses fetal pH and BE

Placental Transfer and Fetal Metabolic Effects of Phenylephrine and Ephedrine during Spinal Anesthesia for Cesarean Delivery

Placental Transfer of Ephedrine and Phenylephrine

**Umbilical Venous : Maternal Arterial**

- Ephedrine: 1.13
- Phenylephrine: 0.17

(Median values)

* *P* < 0.0001
Keeping blood pressure near baseline gives better maternal outcome
Elective Spinal Caesareans ($n=75$)

Crystalloid Prehydration

Phenylephrine Infusion

Three Target Blood Pressures

- 80% of Baseline
- 90% of Baseline
- 100% of Baseline
Incidence of Nausea/Vomiting

Ngan Kee et al. *Br J Anaesth* 2004;92:469-74
How best to use phenylephrine?

- Preparation
- Method of administration
- Timing of administration
Dilute carefully.....
Timing....

**Prevention versus Treatment**

Most effective management:
- Start administration immediately after intrathecal injection
Method....

*Infusion versus Boluses*

- Both effective
- Intermittent bolus simple
- Infusion convenient
- Infusion less work
INFUSION:
• Less hypotension
• More hypertension
• Less nausea/vomiting
• Fewer physician interventions
Phenylephrine Infusions for Maintaining Blood Pressure During Spinal Anesthesia for Cesarean Delivery: Finding the Shoe That Fits

Warwick D. Ngan Kee, BHB, MBChB, MD, FANZCA, FHKCA, FHKAM
Recommendation:  

*Infusion technique:*  

- Syringe pump  
- Start ~50 µg/min immediately after induction  
- Measure BP Q1min  
- Increase rate if BP falls  
- Decrease/stop if BP increases
Recommendation:

**Bolus technique:**

- Bolus dose: 50-100 µg
- Begin immediately after IT injection
- Measure BP Q1min
- Further boluses when BP start to decrease
Recommendation: **What about bradycardia?**

- Associated with ↓ cardiac output
- Tolerate to ~ 50-60 bpm
- BP high/normal: stop and wait!
- BP low: IVF, ephedrine, atropine/glycopyrrolate*

* Beware hypertension with anticholinergics!
Recommendation: What about high risk cases?

- Preeclampsia
- Fetal compromise
- Few studies
- Less vasopressor needed
- Use less aggressive dosing
OUTLINE

• Techniques
• Drug Choice
• Drug Dose
• Fluids
• Vasopressors
OXYGEN

• Should I (not) give oxygen?
• Does it do any good?
• Can it do any harm?
POTENTIAL BENEFITS

- Increase fetal oxygenation
- Reduce effects of hypoventilation
- Protection during prolonged U-D time
- Reduce effects of hypotension
- Safety in conversion to GA
- Decrease nausea & vomiting
- Decrease wound infection
Oxygen Transfer from Mother to Fetus during Cesarean Section under Epidural Anesthesia

Sivam Ramanathan, MD, * Shamala Gandhi, MD, † James Arismendy, AAS, ‡ Jack Chalon, MD, § and Herman Turndorf, MD ||
Supplementary oxygen for elective Caesarean section under spinal anaesthesia: useful in prolonged uterine incision-to-delivery interval?†

K. S. Khaw†, W. D. Ngan Kee†, A. Lee†, C. C. Wang†, A. S. Y. Wong†, F. Ng† and M. S. Rogers†
Elective C-sections (n=204)

High flow venturi facemask

Air

40% O₂

60% O₂

• Cord gases & O₂ content.
• Subanalysis for U-D time >180 s

UV PO$_2$ (mmHg)

- 21%: 28
- 40%: 29
- 60%: 32

* $P = 0.003$

UV Hb Saturation (%)

- 21%: 63
- 40%: 67
- 60%: 70

** $P = 0.015$

UV O$_2$ Content (mL/dL)

- 21%: 12.9
- 40%: 13.4
- 60%: 14.4

*** $P = 0.015$

OXYGEN

- Should I (not) give oxygen?
- Does it do any good?
- Can it do any harm?
Effects of high inspired oxygen fraction during elective Caesarean section under spinal anaesthesia on maternal and fetal oxygenation and lipid peroxidation†

K. S. Khaw†, C. C. Wang², W. D. Ngan Kee¹, C. P. Pang³ and M. S. Rogers²

Oxygen free radical generation
“It seems reasonable, based on current knowledge, to continue to give supplementary oxygen to mothers undergoing emergency/unplanned Caesarean section…”

“In healthy parturients undergoing elective Caesarean section, it would appear that additional oxygen is unnecessary.”
Summary

• Use spinal or CSE
• Heavy bupivacaine + opioid
  (low dose fentanyl 10-15µg)
• Dose: empirical
Summary

- Crystalloid: cohydration
- Colloid: pre- or cohydration
- Don't rely on fluids
- Don't delay for fluids
Summary

- Phenylephrine or metaraminol
- Start early
- Keep BP near baseline
- Care with anticholinergics
Summary

• Routine $O_2$ unnecessary
• Be guided by pulse oximeter
Regional Anaesthesia for Caesarean Section

"The Best Recipe"

Warwick D. Ngan Kee
Dept of Anaesthesia & Intensive Care
The Chinese University of Hong Kong