The Role of the Anaesthesiologist in the Perioperative Management of Preeclampsia

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Interlaken 2017

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In preeclampsia -
• Understanding of pathophysiology
• Assessment of disease severity
• Prediction of cardiopulmonary complications
• Regional anaesthesia
• Monitoring of intravascular volume
• General anaesthesia/Critical care
• Perioperative outcomes
Mortality

- UK, overall
  - 2009-2011: 11† (0.42/100,000)
  - 2012-2014: 3† (0.11/100,000)
- South Africa
  - 2011-2013: 15% of 4452 †
- UK, Cardiopulmonary †: zero recent triennia
- South Africa
  - 50% ‡ due to hypertensive disorders
Pathophysiology: abnormal placentation

- Failure of vascular remodeling of spiral arteries
- Release of inflammatory cytokines
- Release of anti-angiogenic proteins
- Endothelial dysfunction
  - Imbalance between endothelin and thromboxane: vasoconstriction
  - Systemic hypertension
- Reduced organ perfusion – symptoms and signs

Powe, Circulation 2011
Hypertension and haemodynamics in pregnant women – is a unified theory for pre-eclampsia possible?

- Supply demand mismatch
- Pre-, placental, post-placental conditions
- Relative hypoxaemia
- Vasoconstrictors/vasodilators produced
- Increased perfusion of vascular beds
- Endothelial damage, hypertension
Table 1. Diagnostic Criteria for Preeclampsia

<table>
<thead>
<tr>
<th>High blood pressure</th>
<th>and</th>
<th>Proteinuria</th>
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<tbody>
<tr>
<td>≥140 mm Hg systolic or ≥90 mm Hg diastolic on 2 occasions at least 4 hours apart after 20 weeks’ gestational age if previously normal blood pressure</td>
<td>and</td>
<td>≥300 mg per 24-hour urine collection (or equivalent from a timed collection) or</td>
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<td>• ≥160 mm Hg systolic or ≥110 mm Hg diastolic, confirmed within a short interval</td>
<td>• Protein/creatinine ratio ≥0.3 (mg/dL) or</td>
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<td>New onset high blood pressure</td>
<td>• Dipstick reading of 1+ (only if other quantitative methods unavailable)</td>
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<tr>
<td>• ≥140 mm Hg systolic or ≥90 mm Hg diastolic on 2 occasions at least 4 hours apart after 20 weeks’ gestational age</td>
<td>New onset of any of the following severe features;</td>
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<tr>
<td>≥160 mm Hg systolic or ≥110 mm Hg diastolic, confirmed within a short interval</td>
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<td>Thrombocytopenia</td>
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<td>• Platelet count &lt;100,000/µL</td>
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<td>Renal insufficiency</td>
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<td>• Serum creatinine &gt;1.1 mg/dL or</td>
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<td>• Doubling serum creatinine concentration in the absence of other renal disease</td>
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<td>Impaired liver function</td>
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<td>• Doubling normal blood concentrations of liver transaminases and/or</td>
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<td></td>
<td>• Severe persistent right upper quadrant or epigastric pain unresponsive to medication and not due to an alternative diagnosis</td>
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<td>Pulmonary edema</td>
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<td>Cerebral or visual symptoms</td>
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</tbody>
</table>

*Severe features of preeclampsia are defined as having any ≥160 mm Hg systolic or ≥110 mm Hg diastolic or any of the other findings listed.

Source: American College of Obstetricians and Gynecologists Task Force on Hypertension.19
Prediction of adverse maternal outcomes in pre-eclampsia: development and validation of the fullPIERS model


Summary

Background Pre-eclampsia is a leading cause of maternal deaths. These deaths mainly result from eclampsia, uncontrolled hypertension, or systemic inflammation. We developed and validated the fullPIERS model with the aim of identifying the risk of fatal or life-threatening complications in women with pre-eclampsia within 48 h of hospital admission for the disorder.

Age, chest pain or dyspnoea, O₂ saturation, platelet count, creatinine, AST
Strong ion and weak acid analysis in severe preeclampsia: potential clinical significance

C. M. Ortner¹,*, B. Combrinck², S. Allie³, D. Story⁴, R. Landau¹, K. Cain⁵ and R. A. Dyer²

Utility of B-type natriuretic peptides in preeclampsia: a systematic review

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Perioperative Research Group, Department of Anaesthesics, Inkosi Albert Luthuli Central Hospital, Nelson R. Mandela School of Medicine, University of KwaZulu-Natal, Durban, South Africa
Population Health Research Institute, Hamilton Health Sciences, Hamilton, Ontario, Canada
Outcomes Research Consortium, Cleveland, OH, USA
Review Article

**Transthoracic echocardiography in obstetric anaesthesia and obstetric critical illness**

A.T. Dennis

*Department of Anaesthesia, Royal Women’s Hospital, Parkville, Australia*

- Pathophysiology
- Point of care management
Transthoracic echocardiographic assessment of haemodynamics in severe pre-eclampsia and HIV in South Africa

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6 Consultant Cardiologist, Department of Cardiology, St Vincent’s Hospital, Fitzroy, Victoria, Australia
An “inovasoconstrictor” state

Healthy pregnant woman

Woman with untreated preeclampsia

Increased LV mass

Altered ventricular movement

Increased left atrial size

Altered filling of heart

Pericardial effusion

Dennis AT, PhD
Preeclampsia

Early and Late Preeclampsia
Two Different Maternal Hemodynamic States in the Latent Phase of the Disease

Herbert Valensise, Barbara Vasapollo, Giulia Gagliardi, Gian Paolo Novelli

*Hypertension. 2008;52:873-880*

- At 24 weeks:
  - Early onset disease: High SVR, low cardiac output
  - Late onset disease: Low SVR, high cardiac output
- Early onset:
  - Greater percentage > 35 yoa
  - Lower percentage raised BMI
Prevalence of severe LVH, diastolic and systolic dysfunction in early- and late onset preeclampsia
Future of Anesthesiology Is Perioperative Medicine

A Call for Action


In preeclampsia -
• Understanding of pathophysiology
• Assessment of disease severity
• Prediction of cardiopulmonary complications
• Regional anaesthesia
• Monitoring of intravascular volume
• General anaesthesia/Critical care
• Perioperative outcomes
Lung Ultrasound Predicts Interstitial Syndrome and Hemodynamic Profile in Parturients with Severe Preeclampsia

Laurent Zieleskiewicz, M.D., Claire Contargyris, M.D., Clément Brun, M.D., Maxime Touret, M.D., Armand Vellin, M.D., François Antonini, M.D., Laurent Muller, M.D., Ph.D., Florence Bretelle, M.D., Ph.D., Claude Martin, M.D., Marc Leone, M.D., Ph.D.
Multiple reflections of ultrasound beam

Ultrasound beam

Reverberations

Edematous interlobular septa

Comet-tails echographic image
Optic Nerve Sheath Diameter Used as Ultrasonographic Assessment of the Incidence of Raised Intracranial Pressure in Preeclampsia

A Pilot Study

Clément Dubost, M.D.,* Agnès Le Gouez, M.D.,† Viridiana Jouffroy, M.D.,*
Sandrine Roger-Christoph, M.D.,† Dan Benhamou, M.D.,‡ Frédéric J. Mercier, M.D., Ph.D.,§
Thomas Geeraerts, M.D., Ph.D.#

- Optic nerve sheath diameter (ONSD) measurements may offer a practical means of monitoring intracranial pressure trends
- In about 20% of preeclamptic patients, ONSD reaches values compatible with intracranial pressure above 20 mmHg
Incidence of Ultrasound abnormalities in late onset disease

B-pattern 55% PPV and 85% NPV to predict raised LVEDP

- No abnormality: 41%
- Diastolic Dysfunction: 33%
- Systolic Dysfunction: 10%
- Interstitial Pulm. Edema: 24%
- Increased LVEDP: 19%
- Increased ONSD: 28%

"Point-of-care ultrasound abnormalities in severe late onset preeclampsia" Ortner CM, SOAP 2017
Future of Anesthesiology Is Perioperative Medicine

A Call for Action


In preeclampsia -
- Understanding of pathophysiology
- Assessment of disease severity
- Prediction of cardiopulmonary complications
- **Regional anaesthesia**
- **General anaesthesia**
- **Monitoring/Critical care**
- Perioperative outcomes
Spinal Anesthesia in Severe Preeclampsia

Vanessa G. Henke, MD,*† Brian T. Bateman, MD,† and Lisa R. Leffert, MD†

Spinal anesthesia is widely regarded as a reasonable anesthetic option for cesarean delivery in severe preeclampsia, provided there is no indwelling epidural catheter or contraindication to neuraxial anesthesia. Compared with healthy parturients, those with severe preeclampsia experience less frequent, less severe spinal-induced hypotension. In severe preeclampsia, spinal anesthesia may cause a higher incidence of hypotension than epidural anesthesia; however, this hypotension is typically easily treated and short lived and has not been linked to clinically significant differences in outcomes. In this review, we describe the advantages and limitations of spinal anesthesia in the setting of severe preeclampsia and the evidence guiding intraoperative hemodynamic management. (Anesth Analg 2013;117:686–93)

- Urgent blood pressure control, MgSO₄
- No haemorrhage, platelet count > 75 x 10⁹/L
- The method of choice for CS if ventricular function is preserved
- Less hypotension and modest afterload reduction
- SA also preferable if fetal heart trace is non-reassuring
Hemodynamic Changes Associated with Spinal Anesthesia for Cesarean Delivery in Severe Preeclampsia

Original Article

Maternal cardiac output response to colloid preload and vasopressor therapy during spinal anaesthesia for caesarean section in patients with severe pre-eclampsia: a randomised, controlled trial

R. A. Dyer,¹ A. Daniels,² A. Vorster,³ A. Emmanuel,³ M. J. Arcache,³ S. Schulein,³ A. R. Reed,³ C. J. Lombard,⁴ M. F. James⁵ and D. van Dyk³
Effects of vasopressors during CS in preeclampsia

Dyer et al, Anaesthesia in press
Ephedrine (Median 15 mg)  
Phenyl (Median 50 µg)

Percentage change from pre-vaso period

Time in seconds

(Median 15 mg) 
(Median 50 µg)
A randomised comparison of bolus phenylephrine and ephedrine for the management of spinal hypotension in patients with severe preeclampsia and fetal compromise


- Ephedrine 15 (7.5-45) mg vs phenylephrine 100 (50-650) µg
- Primary outcome umbilical arterial base deficit
  - No differences ephedrine vs phenylephrine (-4.9 vs -6.0 mmol.l⁻¹)
- UA pH and lactate levels also similar
  - 7.25 vs 7.22, and 3.41 vs 3.28 mmol.l⁻¹
- No differences in numbers of neonates with
  - 1 minute Apgar scores <7 (31% vs 38%), or
  - pH <7.2 (19% vs 28%)
Pulmonary oedema

- G2P1 severe early onset preeclampsia
- Blood pressure 185/110 mmHg, tachycardia
- Sparse bilateral crackles, respiratory rate 32/minute
- Mg SO$_4$, dihydrallazine
- Pathological CTG
- Spinal anaesthesia
- Acute hypotension, progressive tachypnoea
- Tracheal intubation and general anaesthesia
- Postoperative ventilation, inotropes, diuretics
Hypovolaemia

- 25 year old G1P0, 30 weeks’ gestation
- Abruptio placentae, IUD
- Hb 6 g/dl
- Creatinine 80 µmol/l
- Respiratory rate 28/minute
- PaO₂ 9 kPa
- Heart rate 130 beats/min
- Blood pressure 195/120 mmHg
- Urine output 5-10 ml/hour

*Monitoring of intravascular volume?*
• **Arterial line**
  – Passive leg raising

• **Transthoracic echocardiography**
  – Point of care estimate
  – Stroke volume responsiveness
23/41 patients developed oliguria
12/23 responded to fluid
Response was predicted during passive leg raising by an increase in VTI of 12% (TTE) (75% sensitivity, 100% specificity)
Stroke volume response - LiDCO

dHR = 12.2 - 0.65dSV
Pearson's r = -0.67
p < 0.001

Anaesthesia, in press
Last ACOG guidelines for placement of PAC - 2002!

2016 view:

• No randomised trials
• High complication rate
• Pulmonary oedema multifactorial
• Multiple organ failure, or acute life-threatening complication when preeclampsia is superimposed upon congenital or valvular heart disease

Pulmonary artery catheter flow catheters for directing management in pre-eclampsia (Review) 2012

Li YH, Novikova N
Eclampsia

- Tracheal intubation in a confused eclamptic patient
- Hypertensive
- Bitten her tongue
Approach

• Is tracheal intubation required?
  – Altered mentation
  – Otherwise consider spinal anaesthesia

• What is the best method?

• What pharmacological agent is best?
Approach

- Conventional airway assessment
- Swelling is usually anterior
- RSI or modified RSI
- Transnasal humidified rapid insufflation ventilator exchange (Optiflow: 100% O₂ humidified and warmed @ 40-70 L/min)
- Suxamethonium vs Rocuronium/sugammadex
- Occasionally inhalational induction
- Back-up second generation SGA
  - ProSeal/ILMA/i-Gel
- Channelled videolaryngoscope – Airtraq
Many medications have been used to prevent the hypertensive response to the induction of general anesthesia and laryngoscopy in preeclamptic patients, with varying results. In this focused review, we summarize the available data and pharmacologic profiles of these drugs. Several different drug classes may be used safely; however, magnesium bolus, lidocaine, calcium channel antagonists other than nicardipine, and hydralazine are not recommended. Further research is warranted into the hemodynamic impact of varying the induction drug dose or combining different classes of drugs. (Anesth Analg 2014;119:1350–6)

- Pharmacology, efficacy, side-effects, therapeutic range
- Beta blockers, vasodilators, opiates, magnesium sulphate
- Recommend esmolol 1.5 mg/kg or NTG 2 ug/kg before propofol induction
- Remifentanil 1-1.5 ug/kg also effective; neonatal respiratory depression
- MgSO₄ not recommended as a bolus pre-induction; correspondence in response
Cardiovascular outcomes and anaesthesia
• Coronary, cerebrovascular, or peripheral vascular disease > 90 days: CHAMPS (HR 2)
• Myocardial infarction, coronary re-vascularisation - RR 2.2
• Diabetes – 2-fold increased risk
• End stage renal disease – RR 2.8 - 6.0 (Vikse, 2012)
• Stroke - Increased risk of death (RR 3.59); also HR 1.9 for children
• White matter lesions - 34% vs 21% (Obs Gyn 2014)
• Chronic hypertension (RR 6.07 vs 2.6 for “mild” disease): 52% at 14 years
Conclusions

• Preeclampsia and Perioperative Medicine
• Pathophysiology/prediction of disease severity
• Understand the value of monitoring devices
• Recognise the value of spinal anaesthesia and the importance of obtunding intubation response
• Expect the unexpected!
Preeclampsia in 2017: Obstetric and Anaesthesia Management

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Thank you!