

## Informace



### Porodnická anestezie I

 16.09.2022 - Pátek

**Předsedající:**

 08:30 - 10:00

 Jan Bláha,  Jitka Mannová

 Hypotenze na porodním sále – up to date 2022

20 min

**Přednášející:**  Jan Bláha

# JAN BLÁHA

KLINIKA ANESTEZIOLOGIE, RESUSCITACE  
A INTENZIVNÍ MEDICÍNY

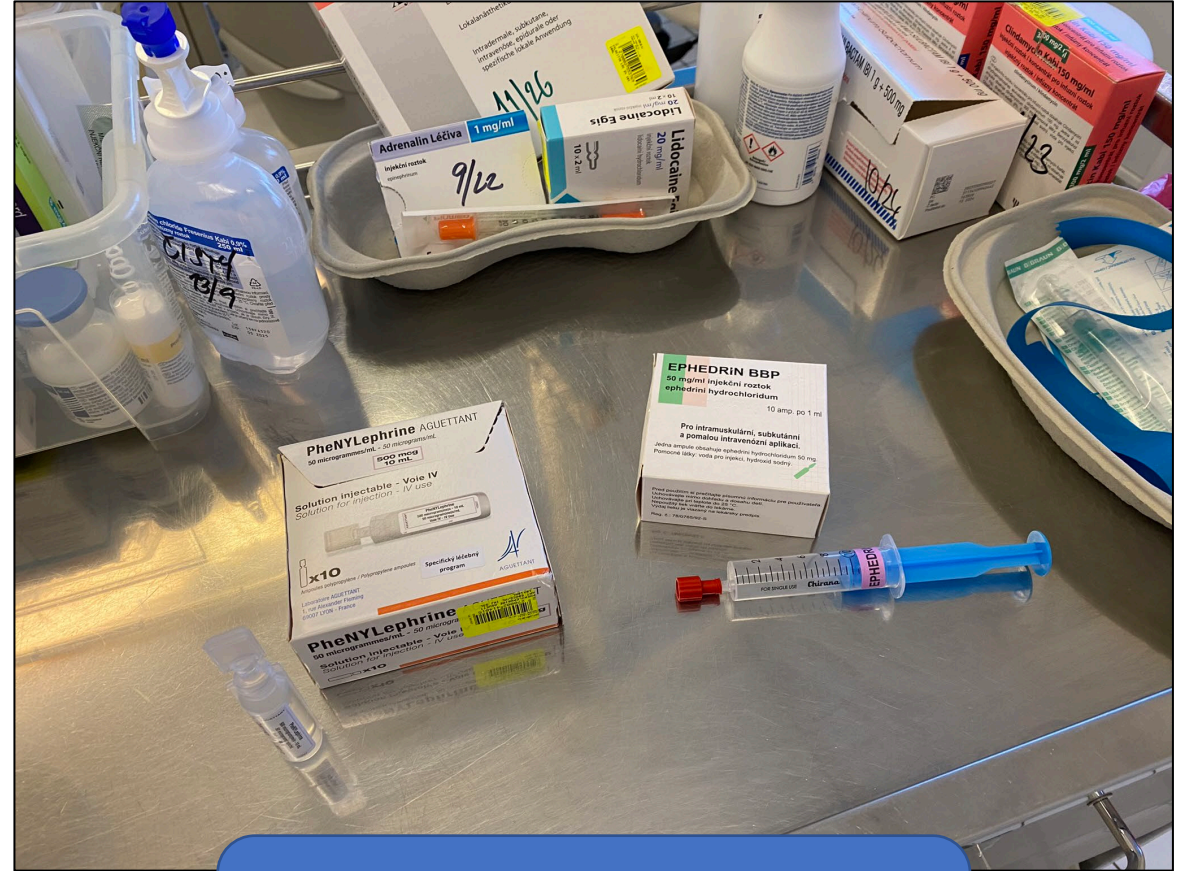


1. LÉKAŘSKÁ  
FAKULTA  
Univerzita Karlova



VŠEOBECNÁ FAKULTNÍ  
NEMOCNICE V PRAZE

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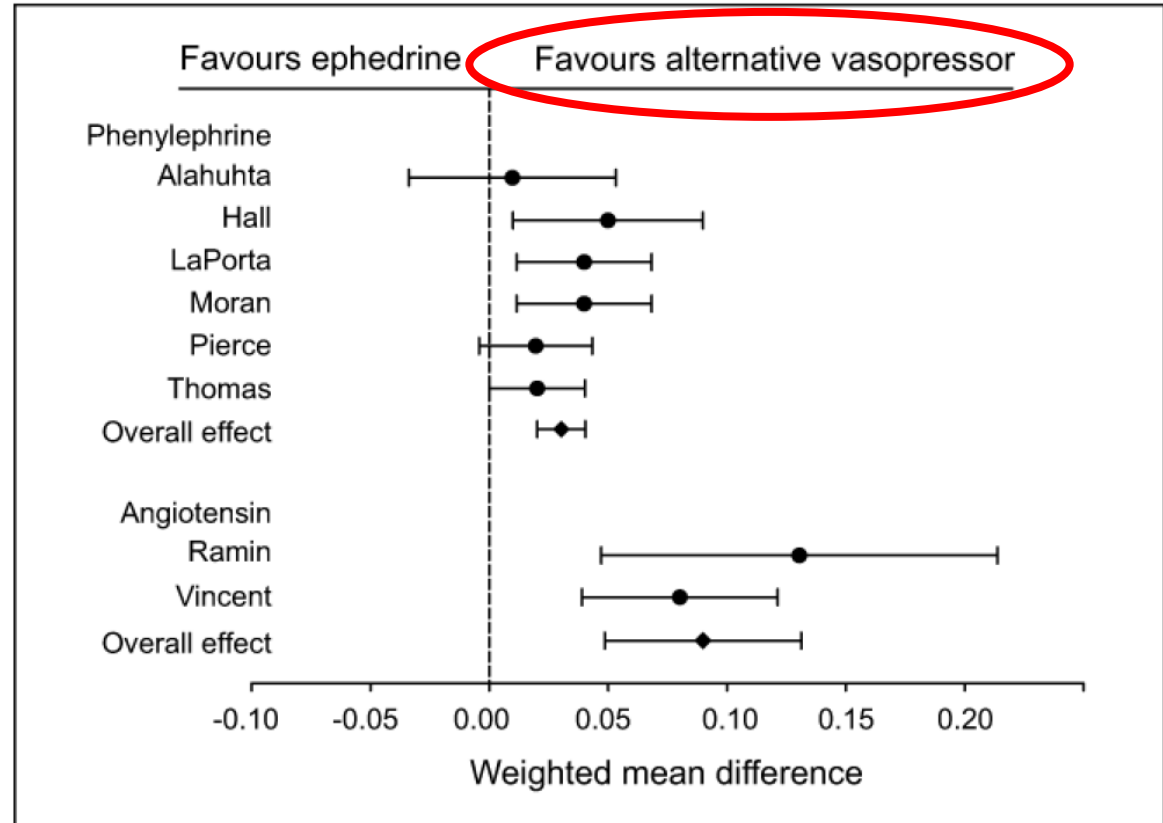


**Phenylephrin je na porodnici  
absolutní POVINOST !!!**

### Vasopressors in obstetrics: what should we be using?

Warwick D. Ngan Kee and Kim S. Khaw

**Figure 1** Meta-analysis of trials comparing phenylephrine and ephedrine for management of hypotension during spinal anesthesia for cesarean section



This shows the effect of choice of vasopressor on umbilical cord arterial pH. Data are mean difference with 95% confidence intervals. (Adapted with permission from [19].)

## Obstetrical and Pediatric Anesthesia

# Prophylactic ephedrine prevents hypotension during spinal anesthesia for Cesarean delivery but does not improve neonatal outcome: a quantitative systematic review

*[L'administration prophylactique d'éphédrine prévient l'hypotension pendant la rachianesthésie pour Césarienne, mais n'améliore pas l'évolution néonatale : une revue méthodique quantitative]*

Anna Lee MPH PhD, Warwick D. Ngan Kee MBCHB MD FANZCA, Tony Gin MBCHB MD FANZCA FRCA

### *Neonatal outcomes*

#### APGAR SCORES

The Apgar scores were recorded at one minute and five minutes in all trials. A low Apgar score at one minute was defined as  $< 7$  in all trials except Webb (1998)<sup>24</sup> and Kang (1982)<sup>22</sup> in which it was defined as  $< 8$ . With the exception of one trial,<sup>1</sup> all neonates had an Apgar score at one minute above the threshold. There was no difference between ephedrine and control groups in the incidence of low Apgar score at one minute (RR, 0.77; 95% CI, 0.29 to 2.06). A low Apgar score at five minutes was defined as  $< 8$  in three trials,<sup>1,7,24</sup> and in all other trials it was defined as  $< 7$ . No neonates had low Apgar score at five minutes. The overall effect size suggested that there was no difference in low Apgar score at five minutes between ephedrine and control groups (RR, 0.72; 95% CI, 0.24 to 2.19).

### *Umbilical pH and fetal acidosis*

The authors reported umbilical arterial pH in eight trials<sup>1,4,11</sup> (trial 1, trial 2),<sup>21–23,25</sup> ( $n = 301$ ) but these trials were heterogeneous (Q statistic = 15.99,  $df = 7$ ,  $P = 0.03$ ). The mean umbilical arterial pH in the control groups ranged from 7.23<sup>25</sup> to 7.29.<sup>1,23</sup> The incidence of fetal acidosis (umbilical arterial pH  $< 7.2$ ) was available in six trials ( $n = 350$ ).<sup>1,4,11</sup> (trial 1, trial 2),<sup>21,23</sup> There was no difference in the risk of fetal acidosis between ephedrine and control groups (RR, 1.36; 95% CI, 0.55 to 3.35). Seven trials<sup>1,4,21,22,24–26</sup> ( $n = 292$ ) reported umbilical venous pH. However, these trials were heterogeneous (Q statistic = 18.60,  $df = 6$ ,  $P < 0.01$ ).

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# **Hypotension During Spinal Anesthesia for Cesarean Section: Does it Affect Neonatal Outcome?**

**M.C. Norris**

*Thomas Jefferson University, Philadelphia, Pennsylvania*

*Regional Anesthesia (1987), 12:191-194*

# Anaesthesia for Caesarean section and neonatal acid-base status: a meta-analysis\*

F. Reynolds<sup>1</sup> and P. T. Seed<sup>2</sup>

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**Table 8** Difference between umbilical artery acid-base values with type of anaesthesia for Caesarean section: results of meta-analysis.

	Comparison	All studies				Randomised trials only			
		#	Difference	95% CI	p	#	Difference	95% CI	p
pH	spinal – general	13	–0.015	–0.029 to –0.001	0.038	5	–0.027	–0.051 to –0.002	0.034
	spinal – epidural	11	–0.013	–0.024 to –0.002	0.025	7	–0.010	–0.022 to 0.01	0.074
	epidural – general	13	–0.006	–0.016 to 0.005	0.317	4	0.001	–0.023 to 0.025	0.938
Base deficit (mEq.l <sup>-1</sup> )	spinal – general	7	1.109	0.434 to 1.784	0.001	2	1.235	–0.821 to 3.290	0.239
	spinal – epidural	7	0.910	0.222 to 1.598	0.010	4	0.834	–0.192 to 0.859	0.111
	epidural – general	8	0.137	–0.198 to 0.471	0.424	2	–0.018	–1.026 to 0.990	0.972

# = number of studies.

## Summary

Spinal anaesthesia is generally preferred for Caesarean section, but its superiority for the baby is often assumed. Umbilical artery acid-base status provides a valid index of fetal welfare. Twenty-seven studies reporting neonatal acid-base data with different types of anaesthesia were used to compare umbilical artery or vein pH and base deficit, using random-effect meta-analysis. Cord pH was significantly lower with spinal than with both general and epidural anaesthesia. Larger doses of ephedrine contributed to the latter effect ( $p = 0.023$ ). Sixteen studies reported a base deficit, which was significantly higher for spinal than for general and epidural anaesthesia.

**Spinal anaesthesia cannot be considered safer than epidural or general anaesthesia for the fetus.**

TABLE 2: Univariate logistic regression analysis of risk factors for intraoperative hypotension in cesarean section women.

Indicators	Control group (n = 599)	Hypotension group (n = 472)	$\chi^2$	p
Age (years)			0.142	0.706
<35	520 (86.81%)	406 (86.02%)		
≥35	79 (13.19%)	66 (13.98%)		
BMI (kg/m <sup>2</sup> )			21.437	<0.001
<30	423 (70.62%)	269 (56.99%)		
≥30	176 (29.38%)	203 (43.01%)		
Gestational age (week)			0.128	0.720
<37	24 (4.01%)	21 (4.45%)		
≥37	575 (95.99%)	451 (95.55%)		

# Analysis of Risk Factors for Intraoperative Hypotension in Cesarean Section and Poor Prognosis of Neonates

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<sup>1</sup>Department of Anesthesiology, The Affiliated Jiangning Hospital, Dongshan Street, Jiangning District, Nanjing 211103, China

**Objective.** To analyze the risk factors of intraoperative hypotension in cesarean section women.

**Methods.** The clinical data of 1071 cesarean section women admitted to Jiangning Hospital from January 2021 to December 2021 were retrospectively analyzed. The hypotension group (n = 472) and normal control group (n = 599) according to whether or not hypotension occurred between the clinical data of cesarean section and the occurrence of hypotension were analyzed by logistic regression analysis. Receiver operating characteristic curve was calculated. **Results.** Logistic regression analysis results showed that BMI ≥ 30 kg/m<sup>2</sup>, infant weight ≥ 3500 g, spinal anesthesia, puncture site L<sub>2-3</sub>, bupivacaine dose > 10 mg, ropivacaine dose > 50 mg, and perfusion index ≥ 4 were risk factors for poor prognosis of neonates. The sensitivity of BMI for the diagnosis of poor prognosis of neonates was 0.5647 (95% CI: 0.5013-0.6280, p = 0.049), and the sensitivity was 51.19% (95% CI: 40.69%-61.59%), and the specificity was 64.34% (61.30%-67.26%). The AUC of BMI for the diagnosis of poor prognosis of neonates was 0.5647 (95% CI: 0.5013-0.6280, p = 0.049), and the sensitivity was 51.19% (95% CI: 40.69%-61.59%), and the specificity was 64.34% (61.30%-67.26%). The AUC of perfusion index for the diagnosis of intraoperative hypotension in cesarean section women was 0.8333 (95% CI: 0.7833-0.8833), and the specificity was 73.12% (69.43%-76.52%). The AUC of infant weight for the diagnosis of poor prognosis of neonates was 0.6164 (95% CI: 0.5538-0.6791, p = 0.001), and the specificity was 50.86% (47.75%-53.97%). **Conclusion.** BMI, infant weight, spinal anesthesia method, puncture site, anesthetic drug dose, and cesarean section maternal hypotension. The prediction model for poor prognosis of neonates and intraoperative hypotension in cesarean section women. The prediction model method, and perfusion index has guiding value for clinical prediction.

TABLE 3: Multivariate logistic regression analysis of risk factors for hypotension during cesarean section.

Index	B	Std. Error	Wald	df	Sig.	Exp(B)	95% CI	
							Lower bound	Upper bound
BMI ≥ 30 kg/m <sup>2</sup>	0.680	0.156	19.056	1	<0.001	1.974	1.454	2.678
Infant weight ≥ 3500 g	0.667	0.151	19.535	1	<0.001	1.949	1.450	2.621
Spinal anesthesia	-0.686	0.16	18.441	1	<0.001	0.504	0.368	0.689
Puncture site L <sub>2-3</sub>	-0.626	0.147	18.116	1	<0.001	0.535	0.401	0.713
Bupivacaine dose > 10 mg	0.814	0.16	25.959	1	<0.001	2.258	1.651	3.089
Ropivacaine dose > 50 mg	1.157	0.253	20.893	1	<0.001	3.182	1.937	5.227
Perfusion index ≥ 4.0	3.555	0.318	125.278	1	<0.001	35.005	18.782	65.241

Indicators	Control group (n = 599)	Hypotension group (n = 472)	$\chi^2$	p
Anemia			0.022	0.083
<2.5	221 (36.89%)	166 (35.17%)		
≥2.5	378 (63.11%)	306 (64.83%)		
Yes	60 (10.02%)	46 (9.75%)		

TABLE 5: Multivariate logistic regression analysis of risk factors for poor neonatal prognosis.

	B	S.E.	Wald	df	Sig.	Exp(B)	95% CI	
							Lower	Upper
BMI ≥ 30 kg/m <sup>2</sup>	0.505	0.235	4.613	1	0.032	1.657	1.045	2.627
Gestational age ≥ 37weeks	-0.777	0.446	3.033	1	0.082	0.46	0.192	1.102
Parity ≥ 1	0.455	0.233	3.796	1	0.051	1.575	0.997	2.489
Umbilical cord around neck	0.564	0.285	3.925	1	0.048	1.758	1.006	3.071
Spinal anesthesia	0.616	0.242	6.485	1	0.011	1.851	1.152	2.973
Puncture site L <sub>2-3</sub>	-0.427	0.251	2.897	1	0.089	0.652	0.399	1.067
Intraoperative hypotension	0.198	0.262	0.572	1	0.449	1.219	0.730	2.036
Time from skin incision to delivery > 12 min	0.153	0.253	0.365	1	0.546	1.165	0.710	1.912
Perfusion index ≥ 4	0.804	0.366	4.831	1	0.028	2.234	1.091	4.573

# Differential Roles of the Right and Left Toe Perfusion Index in Predicting the Incidence of Postspinal Hypotension During Cesarean Delivery

Zifeng Xu, MD, PhD,\* Tao Xu, MD,\* Puwen Zhao, MD,\* Rui Ma, MD,\* Mazhong Zhang, MD, PhD,† and Jijian Zheng, MD, PhD†

**Table 2. Results of Individual Variable Logistic Regression Analysis to Predict the Incidence of Postspinal Hypotension During Elective Cesarean Delivery**

	OR (95% CI)	P Value
Age	0.97 (0.90–1.05)	.43
Height	1.02 (0.93–1.10)	.72
Body weight	1.05 (1.00–1.09)	.0265
BMI (kg/m <sup>2</sup> )	1.14 (1.01–1.28)	.0278
HR (beats/min)	1.04 (1.0–1.07)	.032
PI (left toe) (%)	0.48 (0.32–0.73)	<.0001
PVI (left toe) (%)	1.02 (0.97–1.08)	.42
PI (right toe) (%)	0.49 (0.32–0.75)	.0001
PVI (right toe) (%)	1.01 (0.96–1.07)	.64

Abbreviations: BMI, body mass index; CI, confidence interval; HR, heart rate; OR, odds ratios; PI, perfusion index; PVI, pleth variability index.

## What is the normal perfusion index

What is Perfusion Index (PI) Perfusion Index or PI is the ratio of the pulsatile blood flow to the non-pulsatile static blood flow in a patient's peripheral tissue, such as finger tip, toe, or ear lobe. ... The PI's values range from 0.02% for very weak pulse to 20% for extremely strong pulse.





# Prediction of spinal anesthesia-induced hypotension during elective cesarean section: a systematic review of prospective observational studies

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Neexistuje spolehlivá predikce hypotenze po spinální anestezii

**Results:** Thirty-eight studies (n = 3086 patients) were included. In most studies, patients received 500–1000 mL crystalloid preload or 500–2000 mL crystalloid coload. Vasopressors for post-spinal hypotension were boluses of ephedrine 5–15 mg and/or phenylephrine 25–100 µg in most studies. The hypotension rate varied from 29% to 80% based on the definition. For analysis, > 30 predictors were classified into seven domains: demographic characteristics, baseline hemodynamic variables, baseline sympathovagal balance, postural stress testing, peripheral perfusion indices, blood volume and fluid responsiveness indices, and genetic polymorphism.

**Conclusions:** Environmental and individual factors increased outcome variability, which restricted the value of the autonomic nervous system and peripheral perfusion indices for prediction of spinal anesthesia-induced hypotension. Supine stress tests may reflect parturients' cardiovascular tolerance during hemodynamic fluctuations and may optimize the predictive value of static state predictors. Future research for predicting spinal anesthesia-induced hypotension should focus on composite and dynamic parameters during the supine stress tests.

# Spinal hypotension in obstetrics: Context-sensitive prevention and management

Dominique van Dyk, MBChB UCT, FCA SA, Dr <sup>a, \*</sup>,  
Robert A. Dyer, MBChB UCT, FCA SA, PhD, Professor <sup>a</sup>,  
David G. Bishop, MBChB UCT, FCA SA, PhD, Professor <sup>b, c, 1</sup>

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## Prediction of spinal hypotension

Spinal hypotension occurs in 75% of patients, with severe hypotension (SBP < 80 mmHg) occurring in one in six patients.

## Prevention and treatment of spinal hypotension

**Proaktivní přístup !**

In view of the high incidence of spinal hypotension, there has been a paradigm shift from treatment to prevention. This *proactive* or prophylactic management is generally preferred to purely *reactive* management, particularly in settings where there is no experienced obstetric anaesthetist present.

# Spinal hypotension in obstetrics: Context-sensitive prevention and management

Dominique van Dyk, MBChB UCT, FCA SA, Dr <sup>a, \*</sup>,  
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## *Leg wrapping*

Kuhn et al. confirmed a modest beneficial effect of prophylactic lower limb wrapping in reducing spinal hypotension [14], in keeping with an earlier Cochrane review [29]. The mechanism is thought to be the limitation of early spinal-induced venodilatation.

bandáž DK

## *Fluid therapy*

Recommendations on intravenous fluid administration to prevent spinal hypotension reflect the modern understanding of arteriolar dilatation as the predominant mechanism of hypotension. Fluid loading is a complementary strategy, serving to improve haemodynamic stability attained through the vasopressor use [4]. The traditional crystalloid preload has largely been superseded by the vasopressor use in addition to a fluid co-load.

co-load

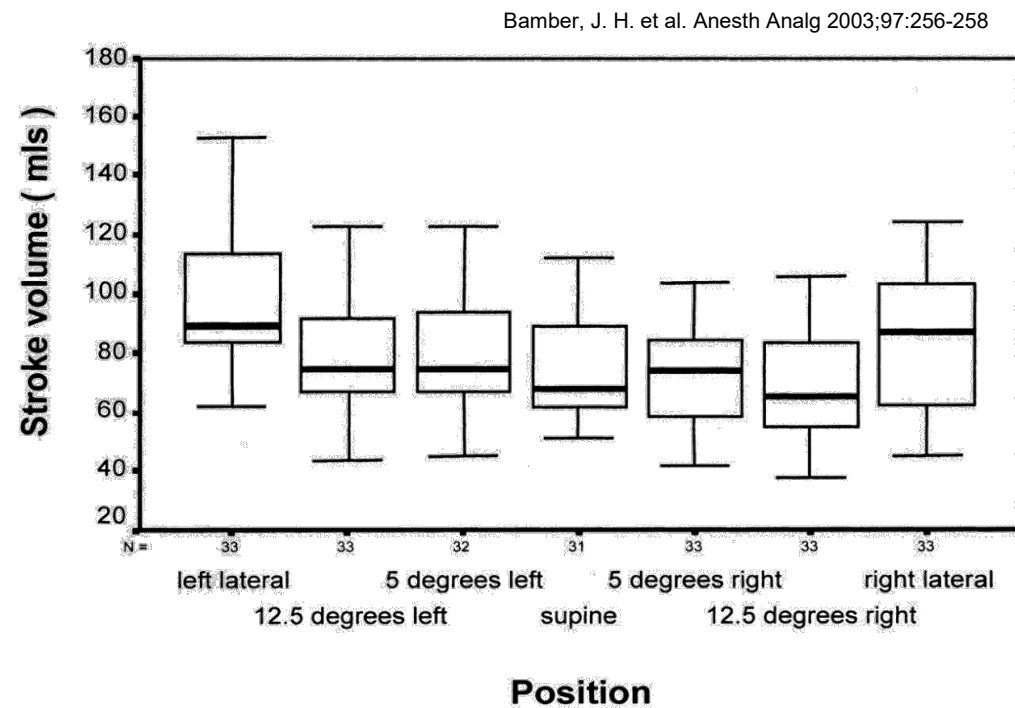
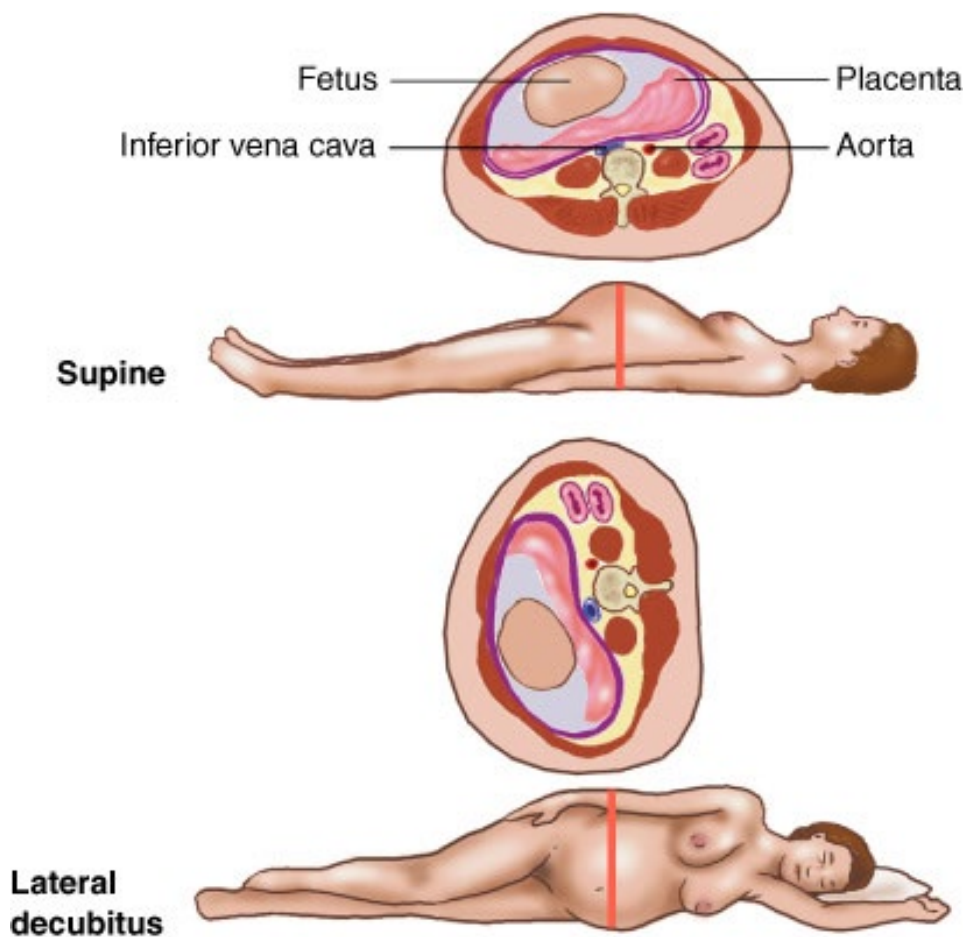
## *Uterine displacement*

Until recently, the left lateral uterine displacement ( $\geq 15^\circ$ ) to alleviate aortocaval compression in the supine position during CS has been a standard component of obstetric practice.

prevenec A-K  
komprese

## SEMILATERÁLNÍ POLOHA

naklonění trupu o 5-15 stupňů = prevence aortokavální komprese



prevence A-K  
komprese

# Spinal hypotension in obstetrics: Context-sensitive prevention and management

Dominique van Dyk, MBChB UCT, FCA SA, Dr <sup>a, \*</sup>,  
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## *Vasopressor prophylaxis and treatment*

The recent consensus view recommends a continuous, variable rate, prophylactic phenylephrine infusion, which is superior to the reactive treatment of established hypotension with intermittent boluses [4]. Phenylephrine, a direct-acting  $\alpha_1$ -adrenergic agonist, possesses suitable pharmacological properties to restore the SVR rapidly to baseline, resulting in a normalisation of heart rate, blood pressure, and cardiac output [12].

**phenylephrin jako  
vasopresor 1. volby**

## *Low-dose spinal anaesthesia*

Reduction of the intrathecal bupivacaine dose to less than 9 mg is regarded as a low-dose obstetric SA. However, a lower incidence of hypotension comes at the cost of more frequent breakthrough pain, particularly if the surgical time exceeds 50 min.

**CAVE příliš malá  
dávka LA**

## REVIEW ARTICLES

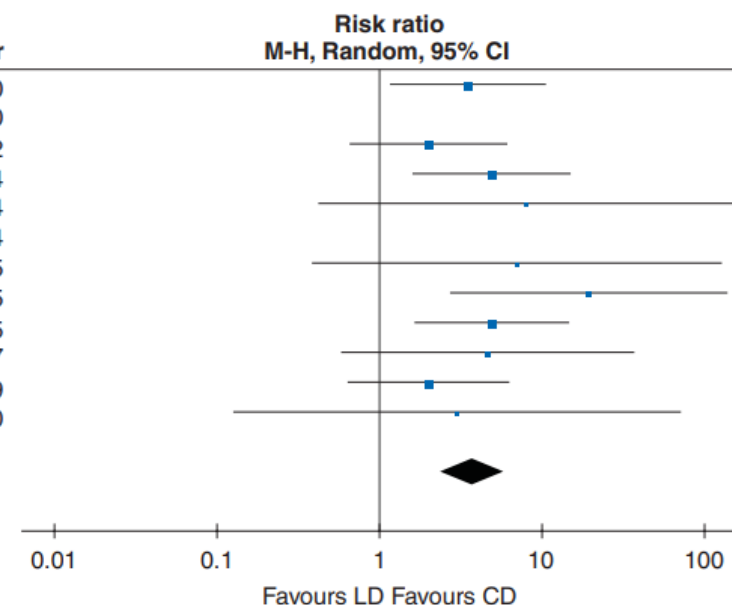
## Efficacy of low-dose bupivacaine in spinal anaesthesia for Caesarean delivery: systematic review and meta-analysis

C. Arzola<sup>1\*</sup> and P. M. Wiecek<sup>2</sup><sup>1</sup> Department of Anesthesia and Pain Management, Mount Sinai Hospital and University of Toronto, 600 University Avenue, Room 1514, Toronto, ON, Canada M5G 1X5<sup>2</sup> SMBD-Jewish General Hospital and McGill University, 3755 Côte Ste-Catherine Road, Room A335, Montreal, QC, Canada H3T 1E2

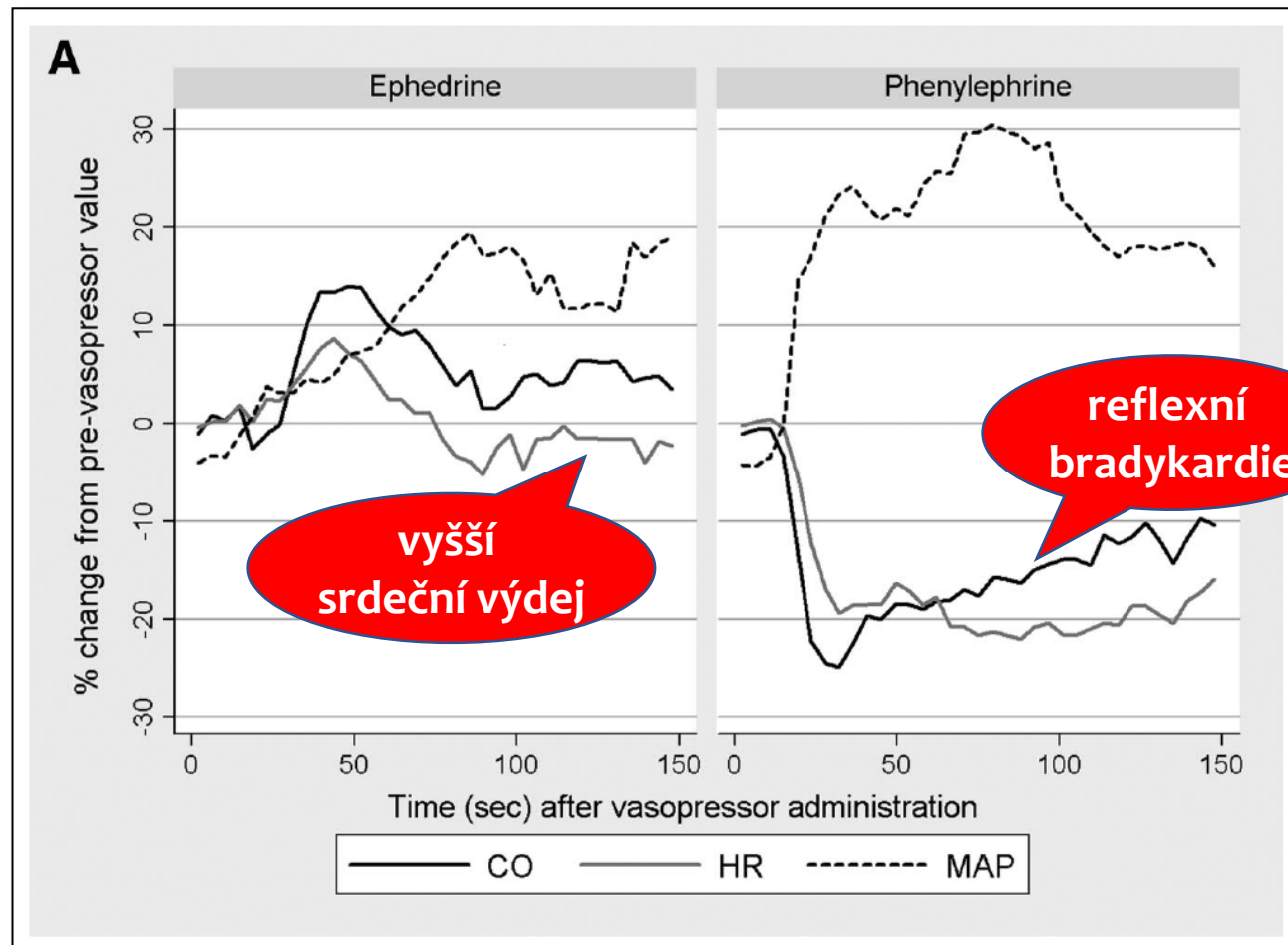
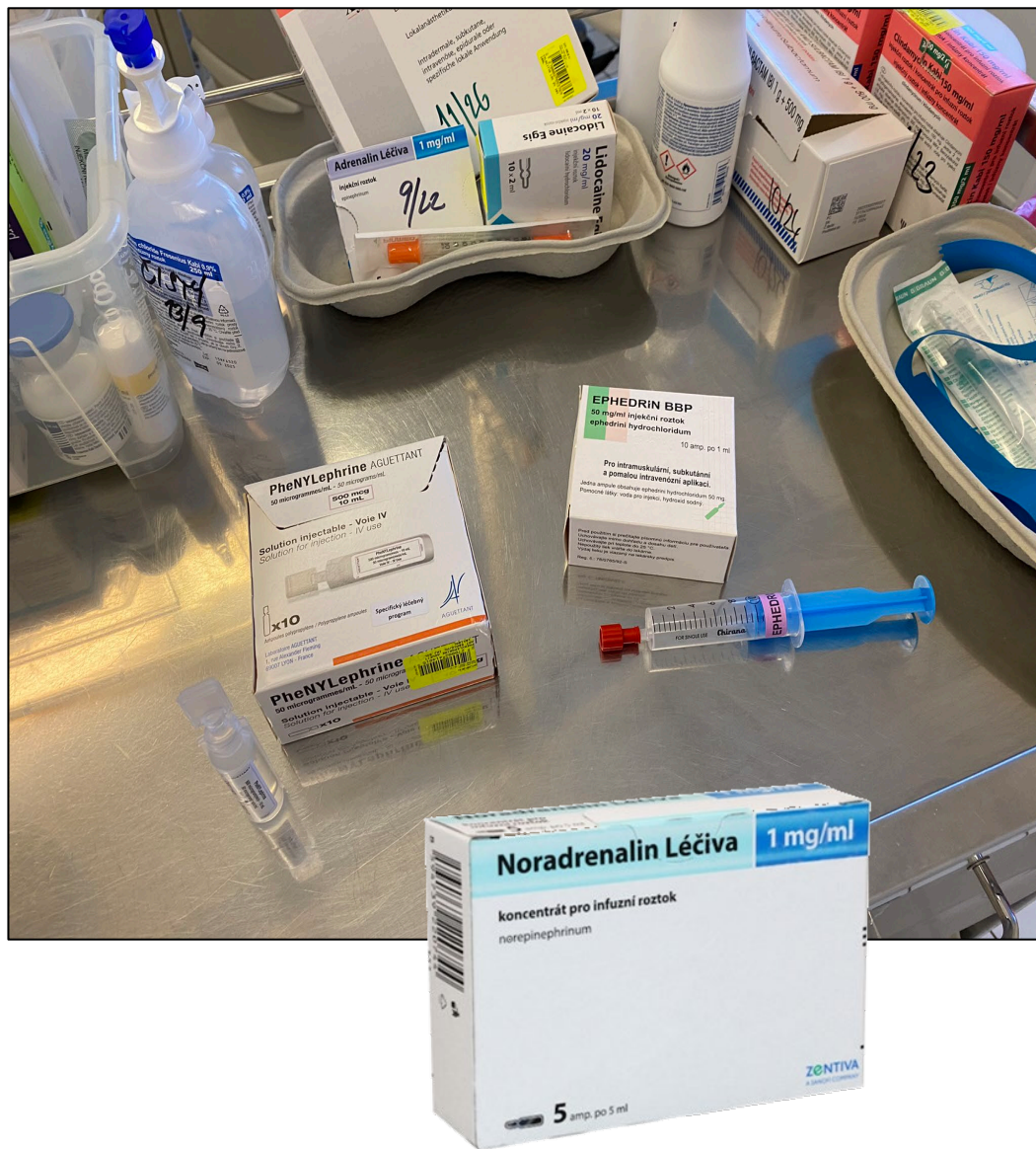
## Editor's key points

- Spinal anaesthesia for Caesarean section is associated with maternal hypotension.
- The incidence may be reduced by the use of a lower dose, but this may reduce block efficacy.
- This meta-analysis of 12 studies with a total of 693 patients used a cut-off dose of  $>8$  or  $\leq 8$  mg.
- Low dose is associated with fewer adverse effects but lower anaesthetic efficacy.

Study or subgroup	Low dose		Conventional dose		Weight	Risk ratio M-H, Random, 95% CI	Year
	Events	Total	Events	Total			
Choi and colleagues-a <sup>21</sup>	7	20	4	40	16.9%	3.50 (1.16, 10.57)	2000
Choi and colleagues-b <sup>21</sup>	0	20	0	40		Not estimable	2000
Kiran and Singal <sup>28</sup>	5	20	5	40	16.6%	2.00 (0.65, 6.11)	2002
Ginosar and colleagues <sup>23</sup>	11	18	3	24	16.5%	4.89 (1.59, 15.00)	2004
Rivero and colleagues <sup>26</sup>	3	51	0	58	2.4%	7.94 (0.42, 150.18)	2004
Nagata and colleagues <sup>31</sup>	0	19	0	14		Not estimable	2004
Guasch and colleagues <sup>27</sup>	3	21	0	21	2.5%	7.00 (0.38, 127.69)	2005
Kimoto and colleagues <sup>32</sup>	10	16	1	31	5.4%	19.38 (2.72, 138.25)	2005
Carvalho and colleagues <sup>22</sup>	16	25	3	23	17.2%	4.91 (1.64, 14.67)	2005
Bryson and colleagues <sup>24</sup>	5	27	1	25	4.8%	4.63 (0.64, 6.29)	2007
Leo and colleagues <sup>29</sup>	12	40	3	20	15.8%	2.00 (0.64, 6.29)	2009
Mebazaa and colleagues <sup>33</sup>	1	40	0	40	2.1%	3.00 (0.13, 71.51)	2010
<b>Total (95% CI)</b>		<b>317</b>		<b>376</b>	<b>100.0%</b>	<b>3.76 (2.38, 5.92)</b>	
Total events	73		20				
Heterogeneity: $\tau^2=0.00$ ; $\chi^2=6.20$ , $df=9$ ( $P=0.72$ ); $I^2=0\%$							
Test for overall effect: $Z=5.70$ ( $P<0.00001$ )							



**Fig 2** Forest plot for analgesic supplementation comparing LD vs CD: individual trials and meta-analysis. *Events*, the total numbers with events (primary outcome=analgesic supplementation) in the intervention (LD) and control (CD) groups; *Total*, the total numbers of participants in the intervention and control groups; *Weight*, sample size contribution of the study relative to the pooled sample size of the meta-analysis; *M-H*, Mantel-Haenszel methods.



# Phenylephrine in the Prevention of Hypotension Following Spinal Anesthesia for Cesarean Delivery

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S. DATTA

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J. Clin. Anesth., 3:301-305, 1991

Ephedrine remains the drug of choice for reversing maternal hypotension following epidural or spinal anesthesia for cesarean section. In view of recent reports indicating that phenylephrine was as effective and safe as ephedrine after epidural anesthesia-induced hypotension, the authors investigated its effectiveness after spinal anesthesia.

The data indicated that the use of phenylephrine, compared with ephedrine, for reversal of maternal hypotension during cesarean section under spinal anesthesia had no adverse effect on neonatal acid-base status or neurobehavioral scores. The two drugs were equally effective in preserving maternal BP. Phenylephrine may have advantages in situations where increases in maternal HR are not desirable, i.e., mitral stenosis.



# Maternal and neonatal effects of bolus administration of ephedrine and phenylephrine during spinal anaesthesia for caesarean delivery: a randomised study

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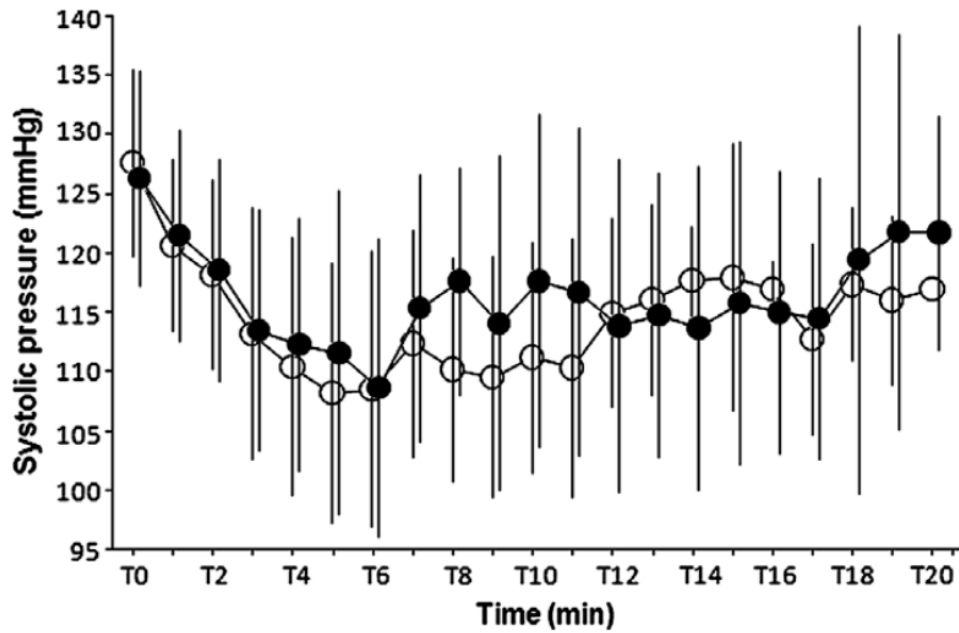


Fig. 2 Serial changes in mean systolic pressure. Changes over time were not significantly different between ephedrine (white circles) and phenylephrine (black circles) groups, except at time-point T8 ( $P = 0.004$ ). Vertical bars represent standard deviations.

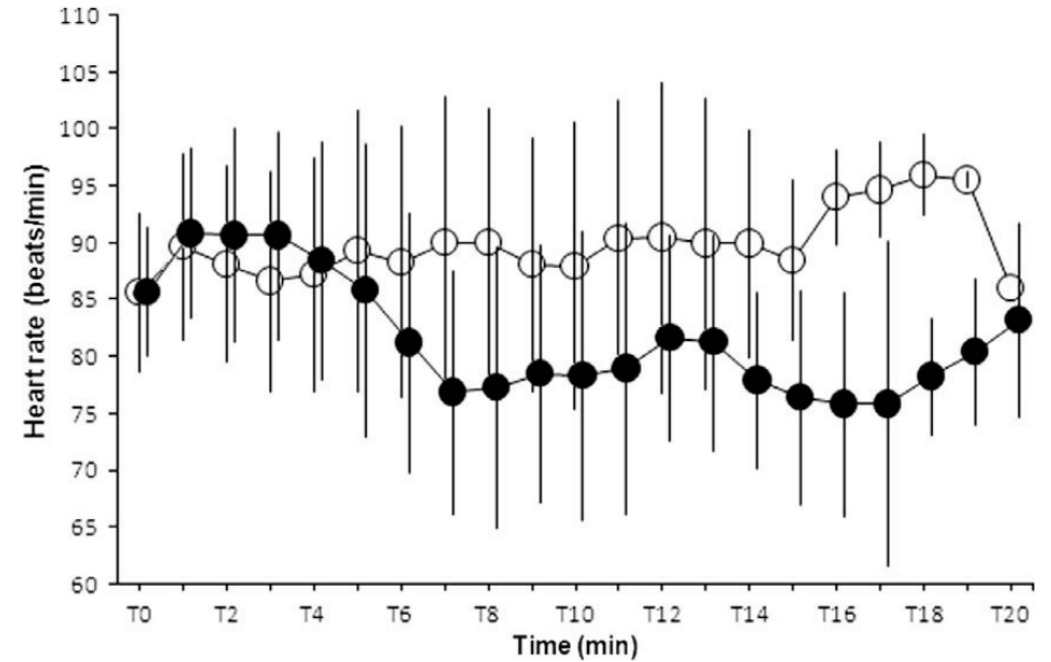


Fig. 3 Serial changes in mean heart rate. Changes over time were significantly different between ephedrine (white circles) and phenylephrine (black circles) groups between time-points T6 to T19 ( $P < 0.05$ ). Vertical bars represent standard deviations.

# Ephedrine versus phenylephrine as a vasopressor for spinal anaesthesia-induced hypotension in parturients undergoing high-risk caesarean section: meta-analysis, meta-regression and trial sequential analysis

M. Heesen,<sup>a</sup> K. Rijs,<sup>b</sup> N. Hilber,<sup>a</sup> W.D. Ngan Kee,<sup>c</sup> R. Rossaint,<sup>d</sup> C. van der Marel,<sup>b</sup> M. Klimek<sup>b</sup>

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Phenylephrin je lepší než efedrin, evidence je ale slabá

Study or Subgroup	Ephedrine		Phenylephrine		Weight	Risk Ratio	
	Events	Total	Events	Total		M-H, Random, 95% CI	M-H, Random, 95% CI
Jain <sup>20</sup>	14	45	9	45	20.0%	1.56 [0.75, 3.22]	

**Conclusions:** Despite several studies and a large number of patients there was insufficient evidence to make a recommendation for choice of vasopressor in high-risk caesarean section. Trials with adequate power to detect differences in the incidence of fetal acidosis between ephedrine and phenylephrine are required to provide evidence-based guidance.

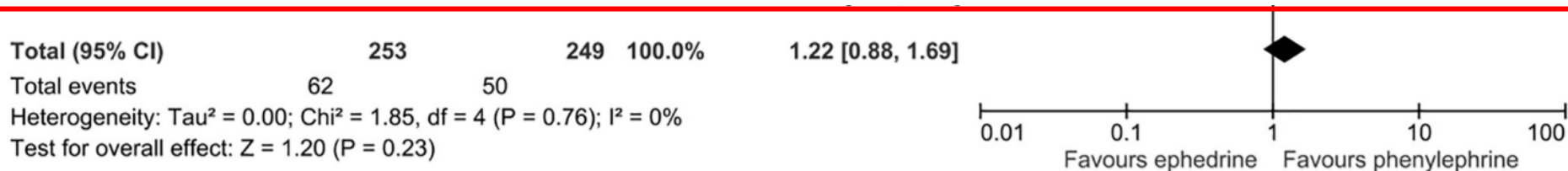


Fig. 3 Meta-analysis of fetal acidosis (umbilical artery pH <7.20)

# Comparison of Phenylephrine and Ephedrine in Treatment of Spinal-Induced Hypotension in High-Risk Pregnancies: A Narrative Review

Sasima Dusitkasem<sup>1,2\*</sup>, Blair H. Herndon<sup>1</sup>, Monsicha Somjit<sup>1,3</sup>, David L. Stahl<sup>1</sup>, Emily Bitticker<sup>1,4</sup> and John

<sup>1</sup>Department of Anesthesiology, The Ohio State University Wexner Medical Center, Columbus, OH, USA, <sup>2</sup>Ramathibodi Hospital, Mahidol University, Bangkok, Thailand, <sup>3</sup>Srinagarin Hospital, Khonkaen University, Khon Kaen, Thailand, <sup>4</sup>University of Cincinnati College of Medicine, Cincinnati, OH, USA

<sup>3</sup>Srinagarin Hospital, Khonkaen University, Khon Kaen, Thailand, <sup>4</sup>University of Cincinnati College of Medicine, Cincinnati, OH, USA

Z hlediska plodu  
je rozdíl nevýznamný ...

**TABLE 1 | Clinical studies comparing the effect of ephedrine and phenylephrine on "fetal outcome" in the setting of uteroplacental hypoperfusion and hypertension**

Reference	Study	Inclusion criteria	Group	N	Spinal anesthesia medication	BP management	Outcomes			End of study
							UA, UV pH	Neonatal	Maternal	
Ngan Kee et al. (29)	Randomized, double-blinded study	Non-elective cesarean section	No vasopressor PE 100 µg bolus E 10 mg bolus	N = 56 N = 74 N = 74	0.5% hyperbaric bupivacaine 10–12 mg with FEN 15 µg	Bolus if SBP < 100 mmHg	No significant differences between group PE and E	No difference in 1- and 5-min Apgar scores or NICU stay	Similar number of hypotensive episodes Higher incidence of nausea or vomiting in group E	Uterine incision
Cooper et al. (30)	Retrospective observational study	High-risk cesarean delivery	No vasopressor PE infusion started at 33 µg/min PE 100 µg bolus E infusion E 6 mg bolus	N = 115 N = 97 N = 51 N = 12 N = 110	0.5% hyperbaric bupivacaine 11–12.5 mg	Not reported	No significant differences between groups	No difference in the incidence of 5-min Apgar score <7, higher incidence of admissions to neonatal unit in group PE than E	No difference in number of hypotensive episodes	Delivery
Mohta et al. (31)	Prospective, randomized, double-blind study	Emergency cesarean section due to fetal compromise	No vasopressor PE 100 µg bolus E 8 mg bolus	N = 30 N = 53 N = 53	0.5% hyperbaric bupivacaine 10–11 mg	Bolus if SBP < 100 mmHg	No significant differences between group PE and E	No significant differences in Apgar scores, number of NICU admissions, or duration of NICU stay	The number of hypotensive episodes were comparable	Delivery
Jain et al. (32)	Prospective, randomized study	Emergency cesarean section due to acute fetal compromise	PE infusion 30 µg/min + PE bolus 50 µg E infusion 2.5 mg/min + E bolus 4 mg	N = 45 N = 45	0.5% hyperbaric bupivacaine 10 mg with FEN 25 µg	Bolus if SBP < 90% of baseline Infusion rate reduced if SBP 110–120% Stopped if SBP > 120%	No significant differences between group PE and E	No difference in number of low 1-min Apgar scores No warrant further observation in pediatric care unit after 24-h F/U	Mean SBP was comparable Higher incidence of nausea or vomiting in group E	Delivery
Ituk et al. (37)	Retrospective observational study	Preeclampsia undergoing cesarean delivery	PE 100 µg bolus E 5 mg bolus	N = 57 N = 89	0.5% hyperbaric bupivacaine 12 mg with FEN 25 µg + MO 250 µg	Not reported	No differences in neonatal UA pH	No difference in 1- and 5-min Apgar score	Not reported	Delivery
Higgins et al. (38)	Prospective, randomized study	Preeclampsia undergoing cesarean delivery	PE infusion 100 µg/min E infusion 8 mg/min	N = 54 N = 54	Not reported	Titrated to keep SBP > 80% of baseline but not >160 mmHg	No significant differences in median UA pH	No difference in 1- or 5-min Apgar score or NICU admission	No difference in maternal SBP	Delivery

BP, blood pressure; SBP, systolic blood pressure; PE, phenylephrine; E, ephedrine; UA pH, umbilical artery pH; UV pH, umbilical venous pH; FEN, fentanyl; MO, morphine; F/U, follow-up; NICU, neonatal intensive care unit.

# Spinal hypotension in obstetrics: Context-sensitive prevention and management

Dominique van Dyk, MBChB UCT, FCA SA, Dr <sup>a, \*</sup>,  
Robert A. Dyer, MBChB UCT, FCA SA, PhD, Professor <sup>a</sup>,  
David G. Bishop, MBChB UCT, FCA SA, PhD, Professor <sup>b, c, 1</sup>

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<sup>b</sup> Department of Anaesthesiology and Critical Care, University of KwaZulu-Natal, South Africa

**Table 1**

Recognition and management of spinal hypotension during caesarean delivery<sup>a</sup>.

Haemodynamic changes	Causes	Recommended management
Hypotension, increased heart rate	Decreased systemic vascular resistance, predominantly arteriolar dilatation, with some venodilatation: sympathetic blockade due to spinal anaesthesia	Phenylephrine
Hypotension, bradycardia	Preload reduction: Bezold-Jarisch or Inverse Bainbridge reflex	Anticholinergic; consider ephedrine. Epinephrine rarely indicated
Severe persistent hypotension	Undiagnosed hypovolaemia Undiagnosed cardiac disease: <ul style="list-style-type: none"> <li>• Peripartum cardiomyopathy</li> <li>• Valvular heart disease</li> <li>• Grown-up congenital heart disease</li> <li>• Rarely, preeclampsia</li> </ul>	Fluids and inotropes if necessary
Cardiorespiratory collapse	High spinal block	Full cardiopulmonary resuscitation

hypotenze s tachykardií = phenylephrin

hypotenze s bradykardií = efedrin

CAVE na jiné příčiny hypotenze

24-year-old woman with dilated cardiomyopathy secondary to Marfan syndrome, aortic arch, aortic valve and mitral valve replacements and a left ventricular ejection fraction of 37%. Epidural anesthesia with 2% lidocaine 20 mL, epinephrine and fentanyl 100 mcg

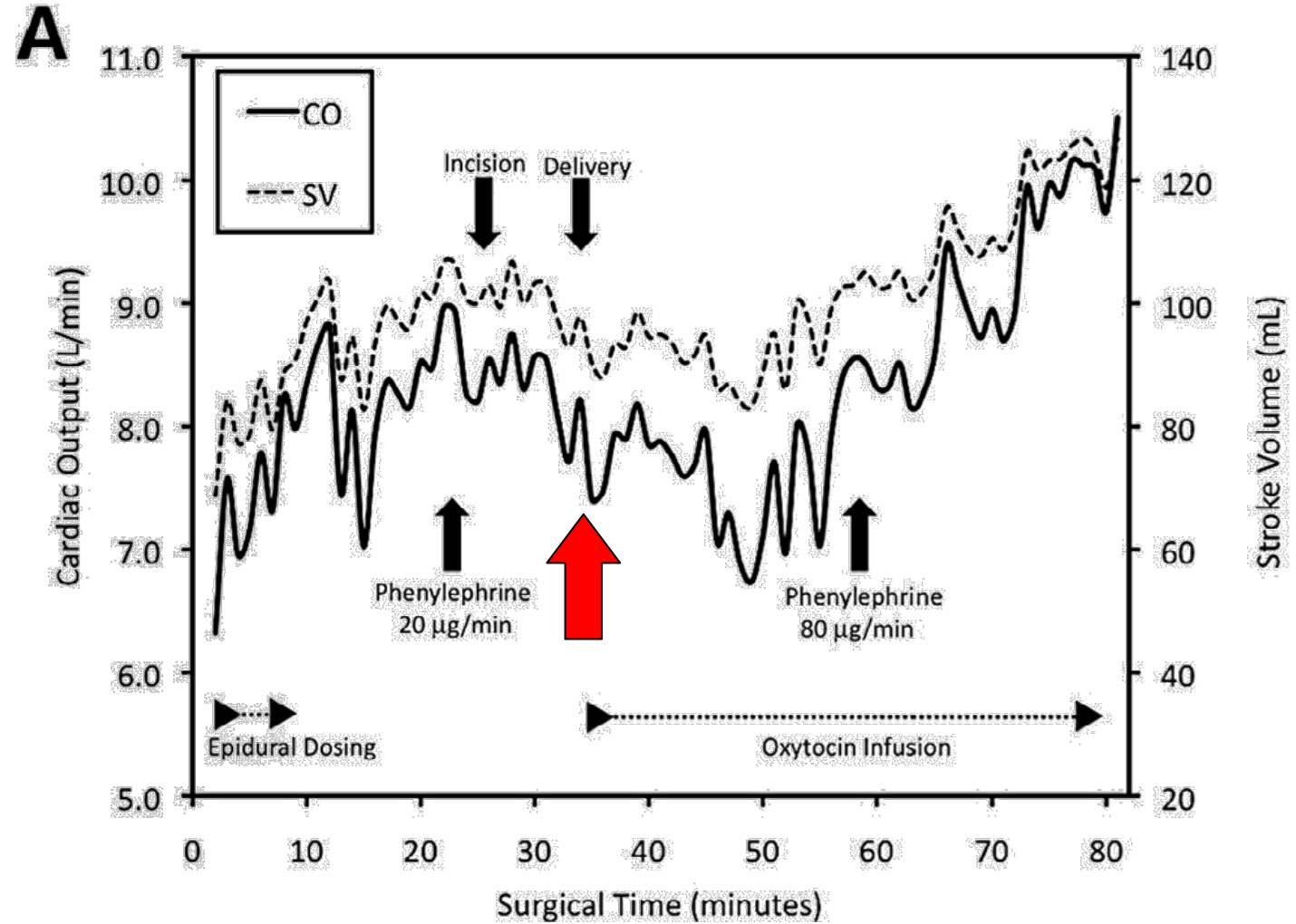
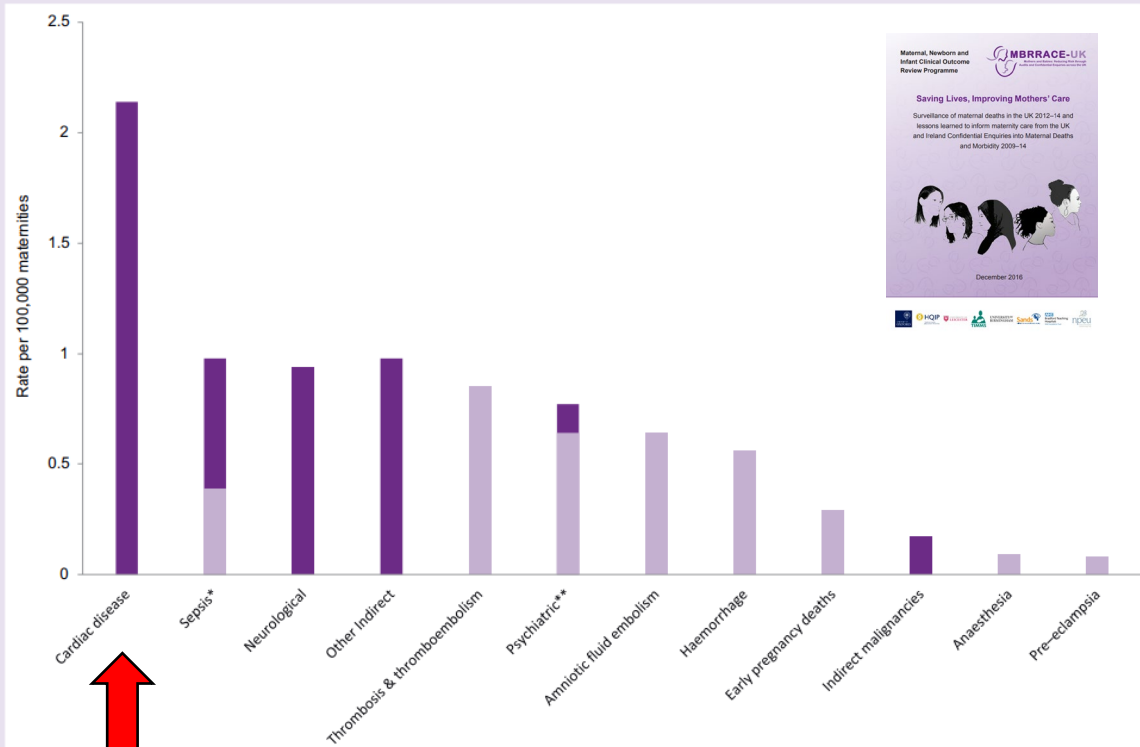


Figure 2.4: Maternal mortality by cause 2012–14



Dark bars indicate indirect causes of death, pale bars show direct causes of death;  
 \*Rate for direct sepsis (genital tract sepsis and other pregnancy related infections) is shown in pale and rate for indirect sepsis (influenza, pneumonia, others) in dark bar  
 \*\*Rate for suicides is shown in pale and rate for indirect psychiatric causes (drugs/alcohol) in dark bar  
 Source: MBRRACE-UK

## Evolution of Maternal Mortality from Heart Disease in the UK

### Cardiac



Roos-Hesselink et al. *Heart* 2009;95:680-6

[www.escardio.org/guidelines](http://www.escardio.org/guidelines)

European Heart Journal 2011, doi: 10.1093/eurheartj/ehr218



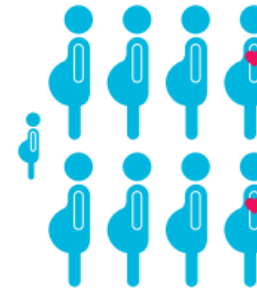
## Saving Lives, Improving Mothers' Care

Surveillance of maternal deaths in the UK 2012–14 and  
lessons learned to inform maternity care from the UK  
and Ireland Confidential Enquiries into Maternal Deaths  
and Morbidity 2009–14



December 2016

## Key messages from the report 2016



**8.5** women per 100,000 died during pregnancy or up to six weeks after giving birth or the end of pregnancy in 2012 - 14

**2** women per 100,000 died from **heart** **disease**



**Persistent breathlessness** when lying flat is **not normal** in pregnancy and may mean heart problems



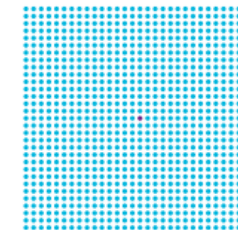
Women known to have **heart disease** are **high risk** and need specialist care



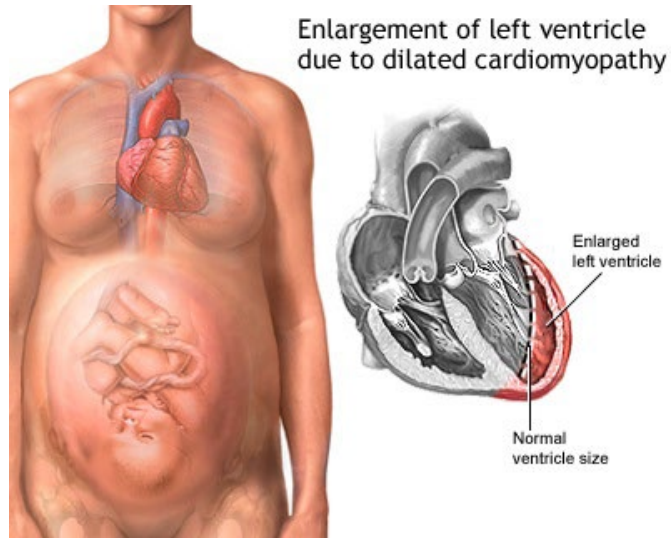
Be aware severe **chest pain** spreading to the left arm or back may be **cardiac**

### Good care makes a difference

Less than **1 woman in every million** who gives birth now dies from **pre-eclampsia**, but to detect it blood pressure and urine must be checked at every antenatal visit



# PERIPARTÁLNÍ KARDIOMYOPATIE



- pomalá infuze **oxytocinu** (<2 IU/min)
- **kontraindikace metylergometrinu**  
(10% riziko výrazné vasokonstrikce a hypertenze)
- **poporodní monitorace 24-72 hod**





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ORIGINAL ARTICLE

# A comparison of the haemodynamic effects of lateral and sitting positions during induction of spinal anaesthesia for caesarean section

B.I. Obasuyi, S. Fyneface-Ogan, C.N. Mato

*Department of Anaesthesia, University of Port Harcourt Teaching Hospital, Port Harcourt, Nigeria*

## ABSTRACT

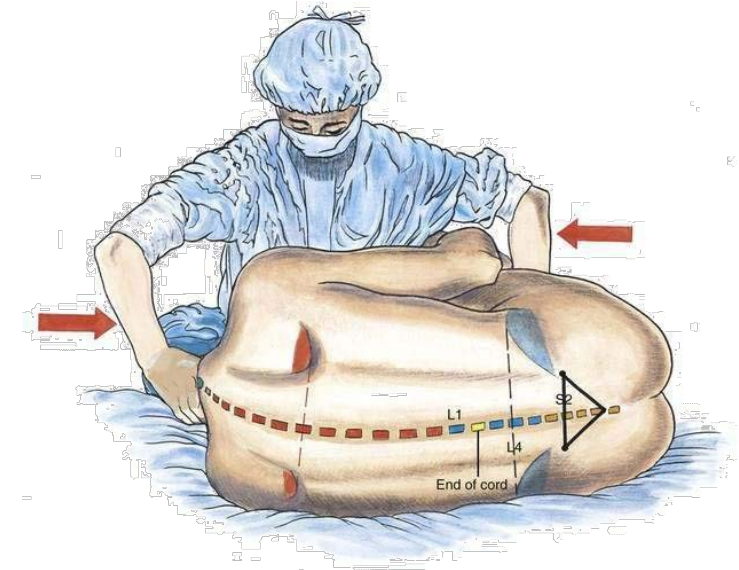
**Background:** Hypotension during spinal anaesthesia occurs commonly in parturients. By influencing spread of local anaesthetic, maternal position may affect the speed of onset of sensory block and thus the haemodynamic effects. The aim of this study was to determine whether inducing spinal anaesthesia for caesarean section using plain bupivacaine in the lateral position would result in less hypotension compared with the sitting position.

**Methods:** One hundred American Society of Anesthesiologists physical status I and II patients undergoing elective caesarean section were randomised to receive spinal anaesthesia in the lateral position (Group L) or the sitting position (Group S). Using the L3-4 interspace, patients received intrathecal plain bupivacaine, 10 mg or 12 mg according to their height, after which they were placed immediately in the supine position with left uterine displacement. Maternal blood pressure was measured every minute for 10 min, every three min for 20 min and 5-minutely thereafter. Hypotension was defined as a fall in systolic blood pressure >20% or a value <90 mmHg.

**Results:** There was no difference in the lowest recorded systolic blood pressure in Group L ( $99.2 \pm 8.9$  mmHg) compared with Group S ( $95.4 \pm 12.3$  mmHg,  $P = 0.081$ ). However, the lowest recorded mean arterial pressure was greater in Group L ( $72.9 \pm 11.2$  mmHg) than in Group S ( $68.2 \pm 9.6$  mmHg;  $P = 0.025$ ). The incidence of hypotension was lower in Group L (17/50, 34%) than in Group S (28/50, 56%;  $P = 0.027$ ). Onset of hypotension was similar between groups.

**Conclusion:** Hypotension occurred less frequently when spinal anaesthesia for caesarean using plain bupivacaine was induced with patients in the lateral compared with the sitting position. Values for the lowest recorded mean arterial pressure were greater but values for the lowest recorded systolic blood pressure were similar for patients in the lateral position group.

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**Table 3 Haemodynamic data, ephedrine use and intraoperative blood loss**

	Group L (n = 50)	Group S (n = 50)	<i>P</i> value
Baseline SBP (mmHg)	122.4 ± 8.6	124.2 ± 9.9	0.3
Baseline MAP (mmHg)	93.0 ± 7.8	91.8 ± 8.9	0.4
Baseline heart rate (beats/min)	91.4 ± 8.5	92.3 ± 11.4	0.6
Incidence of hypotension	17 (34%)	28 (56%)	0.027
Time from IT injection to first hypotension (min)	11.8 ± 10.7	9.8 ± 8.2	0.5
Lowest SBP within 30 min of IT injection (mmHg)	99.2 ± 8.9	95.4 ± 12.3	0.08
Lowest MAP within 30 min of IT injection (mmHg)	72.9 ± 11.2	68.2 ± 9.6	0.02
Lowest heart rate within 30 min from IT injection (beats/min)	83 ± 11	79 ± 10	0.05
Incidence of ephedrine use	3 (6%)	5 (10%)	0.4
Total dose of ephedrine (mg)	5 ± 0	5 ± 0	1
SBP <90 mmHg	7 (14%)	14 (28%)	0.08
Blood loss (mL)	631 ± 171	697 ± 241	0.1

Data are mean ± SD or as number (%). SBP: systolic blood pressure; MAP: mean arterial pressure; IT: intrathecal.

**Table 5 Incidence of complications**

	Group L (n = 50)	Group S (n = 50)	<i>P</i> value
Nausea	2 (4%)	4 (8%)	0.4
Vomiting	0 (0%)	1 (2%)	0.3
Shivering	7 (14%)	11 (22%)	0.2
Dizziness/sleepiness	3 (6%)	5 (10%)	0.4
Respiratory distress	2 (4%)	7 (14%)	0.08

Data are number (%).

**SAB aplikovaný v sedě má vyšší výskyt hypotenze než při aplikaci na boku**

## The Effects of Maternal Position During Induction of Combined Spinal-Epidural Anesthesia for Cesarean Delivery

Esther M. Yun, MD\*, Gertie F. Marx, MD\*, and Alan C. Santos, MD\*†

Departments of \*Anesthesiology and †Obstetrics and Gynecology, Albert Einstein College of Medicine/Montefiore Medical Center, Bronx, New York

**Table 2.** Block Characteristics, Changes in Blood Pressure, Ephedrine Used, and Incidence of Nausea and Vomiting

	Position for combined spinal-epidural placement	
	Sitting	Lateral recumbent
Dermatomal segments blocked <sup>a</sup>	21 ± 1	22 ± 2
Time to achieve highest sensory block (min) <sup>a</sup>	8 ± 3	6 ± 2
Duration of SBP below baseline (min)	6 ± 3*	3 ± 2
Decrease in SBP (%)	47 ± 7*	32 ± 14
Ephedrine used (mg)	38 ± 18*	17 ± 12
Nausea (%)	50	50
Vomiting (%)	33	30

Values are mean ± SD.

SBP = systolic blood pressure.

<sup>a</sup> Sensory block was assessed by pinprick.

\* Significantly greater than the lateral recumbent group ( $P < 0.05$ ).

## The Sitting Versus Right Lateral Position During Combined Spinal-Epidural Anesthesia for Cesarean Delivery: Block Characteristics and Severity of Hypotension

Hilde C. Coppejans, MD, Ellen Hendrickx, MD, Joris Goossens, MD, and Marcel P. Vercauteren, MD, PhD

**Table 2.** Hemodynamic Effects

	Lateral (n = 28)	Sitting (n = 28)	P value
Incidence of hypotension	11 (40)	5 (18)	0.1
Ephedrine supplement (%)	16 (57)	10 (32)	0.1
Lowest SBP (mm Hg)	100 (19)	113 (19)	0.019
Ephedrine (mg)	14.5 (12)	8.0 (5)	0.012
Time from CSE to first hypotension (min)	6 (2)	20 (5)	0.002
SBP < 100 mm Hg	14 (50)	6 (21)	0.05
SBP < 90 mm Hg	7 (25)	3 (11)	0.3
Nausea /vomiting	15/1 (53/3)	10/1 (35/3)	0.6

Data are expressed as mean (SD) or as number (%). SBP = systolic blood pressure; CSE = combined spinal-epidural.

## The Sitting Versus Right Lateral Position During Combined Spinal-Epidural Anesthesia for Cesarean Delivery: Block Characteristics and Severity of Hypotension

Hilde C. Coppejans, MD, Ellen Hendrickx, MD, Joris Goossens, MD, and Marcel P. Vercauteren, MD, PhD

**Table 3.** Block Characteristics

	Lateral (n = 28)	Sitting (n = 28)	P value
Technical difficulties	11 (39)	2 (7)	0.01
Highest sensory level Range	T2 (T1–T6)	T4 (C8–T4)	0.014
Sensory block >T3	14 (50)	5 (18)	0.04
Motor block Bromage–3 (incision)	11 (39)	13 (46)	0.79
Motor block Bromage >1 (end surgery)	12 (43)	14 (50)	0.79
Epidural supplementation	1 (3)	10 (35)	0.007
Time from CSE to incision (min)	18 (5)	19 (5)	0.4
Time from CSE to delivery (min)	27 (7)	28 (6)	0.6
Time from CSE to end of surgery (min)	54 (10)	62 (9)	0.006

Data are expressed as mean (SD or range) or as number (%). CSE = combined spinal-epidural.

**Table 2.** Hemodynamic Effects

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SBP < 90 mm Hg	7 (25)	3 (11)	0.3
Nausea /vomiting	15/1 (53/3)	10/1 (35/3)	0.6

Data are expressed as mean (SD) or as number (%). SBP = systolic blood pressure; CSE = combined spinal-epidural.

# Randomized Double-blinded Comparison of Norepinephrine and Phenylephrine for Maintenance of Blood Pressure during Spinal Anesthesia for Cesarean Delivery

Warwick D. Ngan Kee, M.B.Ch.B., M.D., F.A.N.Z.C.A., F.H.K.A.M.,  
Shara W. Y. Lee, B.Sc.(Hons.), M.Sc., Ph.D., Floria 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.



## ABSTRACT

**Background:** During spinal anesthesia for cesarean delivery, phenylephrine can cause reflexive decreases in maternal heart rate and cardiac output. Norepinephrine has weak  $\beta$ -adrenergic receptor agonist activity in addition to potent  $\alpha$ -adrenergic receptor activity and therefore may be suitable for maintaining blood pressure with less negative effects on heart rate and cardiac output compared with phenylephrine.

**Methods:** In a randomized, double-blinded study, 104 healthy patients having cesarean delivery under spinal anesthesia were randomized to have systolic blood pressure maintained with a computer-controlled infusion of norepinephrine 5  $\mu\text{g}/\text{ml}$  or phenylephrine 100  $\mu\text{g}/\text{ml}$ . The primary outcome compared was cardiac output. Blood pressure heart rate and neonatal outcome were also compared.

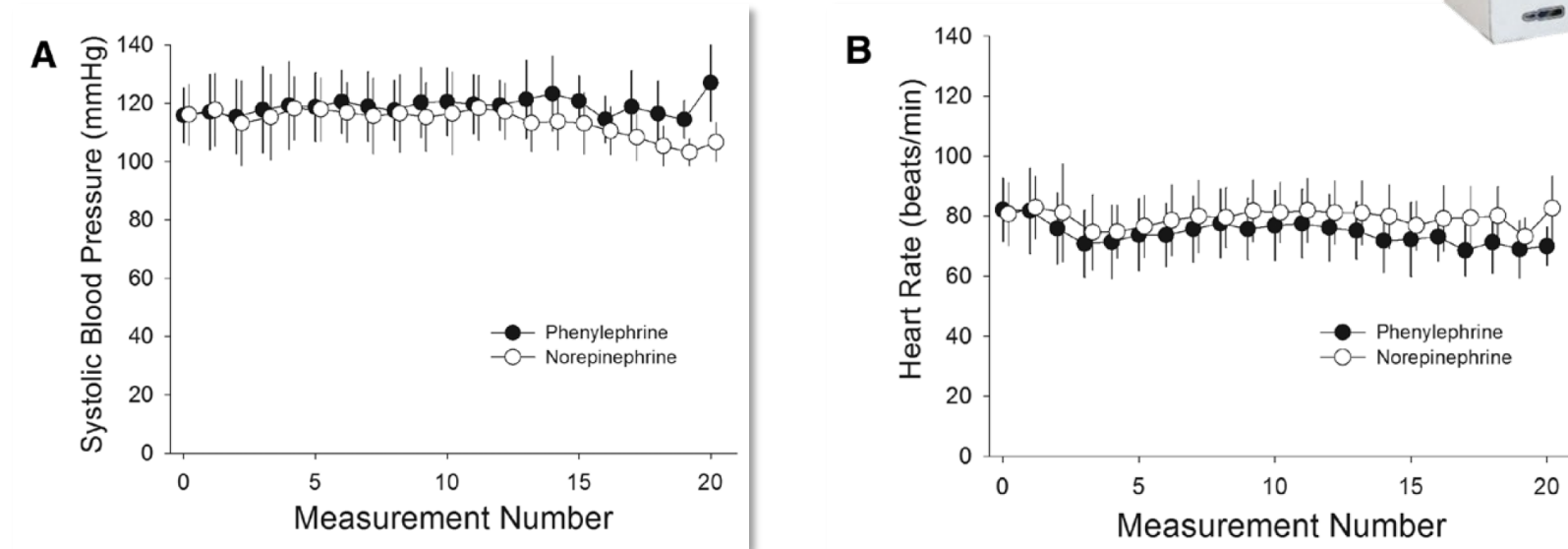
**Results:** Normalized cardiac output 5 min after induction was greater in the norepinephrine group (median 102.7% [interquartile range, 94.3 to 116.7%] versus 93.8% [85.0 to 103.9.8%, 95% CI of difference between medians 2.8 to 16.1%). From induction until uterine incision, with norepinephrine, systolic blood pressure and stroke volume were similar, heart rate and cardiac output were higher, and systemic vascular resistance was lower, and the incidence of bradycardia was smaller. Neonatal outcome was similar between groups.

**Conclusions:** When given by computer-controlled infusion during spinal anesthesia for cesarean delivery, norepinephrine was effective for maintaining blood pressure and was associated with greater heart rate and cardiac output compared with phenylephrine. Further work would be of interest to confirm the safety and efficacy of norepinephrine as a vasopressor in obstetric patients. ([ANESTHESIOLOGY 2015; 122:736-45](#))

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ale vyšší TF a CO

# Randomized Double-blinded Comparison of Norepinephrine and Phenylephrine for Maintenance of Blood Pressure during Spinal Anesthesia for Cesarean Delivery

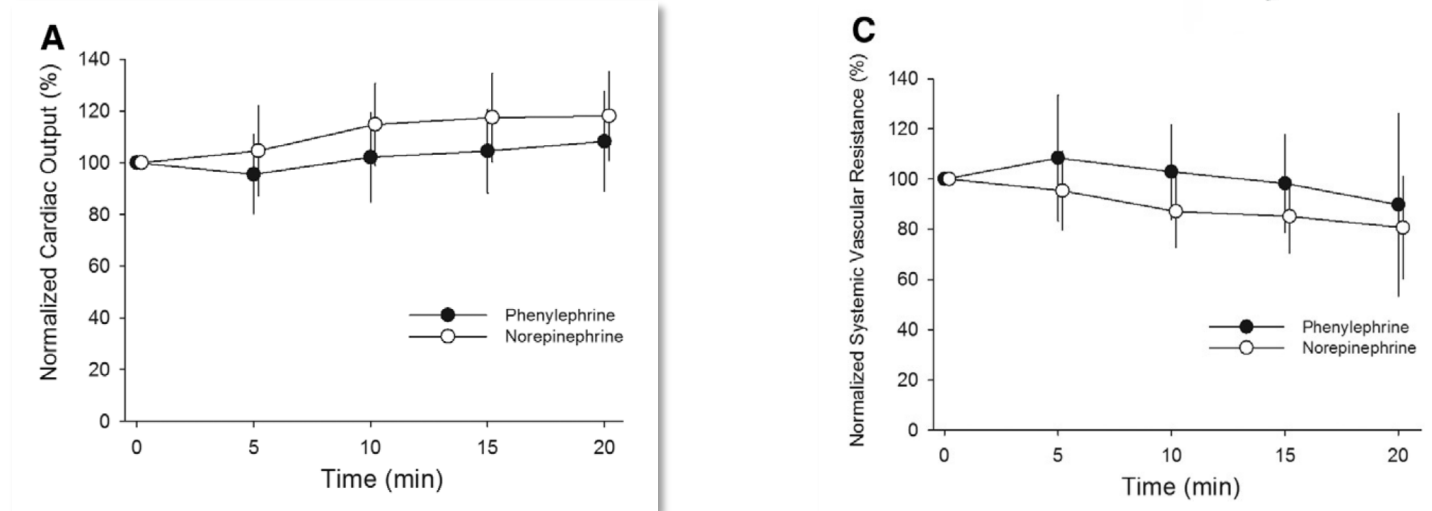
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**Fig. 2.** Serial changes in systolic blood pressure (A) and heart rate (B). On the left side of the panels, data are serial values for the first 20 measurements shown as mean and SD. Because the noninvasive blood pressure monitor took a variable time to start and complete each blood pressure measurement, tick values on the horizontal axis represent the sequential number of each measurement made with the monitor set to an automatic 1-min cycling time rather than exact chronological time. On the right side of the panels, bars show the area under the curve for the two groups (N = norepinephrine and P = phenylephrine) standardized for each patient by dividing by the number of data points recorded and shown as median and interquartile range. Comparison of the calculated values for standardized area under the curve showed that systolic blood pressure was similar between groups ( $P = 0.36$ ), but heart rate was greater over time in the norepinephrine group *versus* the phenylephrine group ( $P = 0.039$ ).

# Randomized Double-blinded Comparison of Norepinephrine and Phenylephrine for Maintenance of Blood Pressure during Spinal Anesthesia for Cesarean Delivery

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**Fig. 3.** Serial changes in cardiac output (A), stroke volume (B), and systemic vascular resistance (C). On the left side of the panels, data are serial values for the first 20 min after induction of spinal anesthesia normalized to percentage of baseline values. On the right side of the panels, bars show the area under the curve for the two groups (N = norepinephrine and P = phenylephrine). Comparison of the calculated values for area under the curve showed that cardiac output was greater over time ( $P < 0.001$ ) and systemic vascular resistance was lower over time ( $P < 0.001$ ) in the norepinephrine group compared with that in the phenylephrine group, but there was no difference in stroke volume ( $P = 0.44$ ). Values are shown as median and interquartile range.

# Spinal hypotension in obstetrics: Context-sensitive prevention and management

Dominique van Dyk, MBChB UCT, FCA SA, Dr <sup>a, \*</sup>,  
Robert A. Dyer, MBChB UCT, FCA SA, PhD, Professor <sup>a</sup>,  
David G. Bishop, MBChB UCT, FCA SA, PhD, Professor <sup>b, c, 1</sup>

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<sup>b</sup> Department of Anaesthesiology and Critical Care, University of KwaZulu-Natal, South Africa

phenylephrin profylakticky, co-load,  
prevence A-K komprese

noradrenalin zatím ještě ne

## Practice points

- After careful exclusion of patients in whom SA is contraindicated, a prophylactic, titrated phenylephrine infusion commenced with a colloid or crystalloid co-load is recommended in low-risk women, with maintenance of left uterine displacement.
- Current evidence does not support substituting phenylephrine with norepinephrine as the first line vasopressor.
- Recent research provides guidance on the safe vasopressor use for spinal hypotension in women with preeclampsia undergoing urgent CS for maternal and/or fetal indications.
- For other high-risk groups such as women with obesity, cardiac disease, and prematurity, there are less robust data underpinning the optimal vasopressor strategy.

pro vysoce rizikové je málo dat  
doporučit konkrétní vasopresor



## REVIEW ARTICLE

## Vasopressor drugs for the prevention and treatment of hypotension during neuraxial anaesthesia for Caesarean delivery: a Bayesian network meta-analysis of fetal and maternal outcomes

Preet M. Singh<sup>1,\*</sup>, Narinder P. Singh<sup>2</sup>, Matthew Reschke<sup>3</sup>, Warwick D. Ngan Kee<sup>4</sup>,

**Results: We included 52 RCTs with a total of 4126 patients.**

<sup>1</sup>Baltimore, MD, USA and <sup>2</sup>Department of Anesthesiology, Siara Medicine, Doha, Qatar

### Abstract

**Background:** The optimal choice of vasopressor drugs for managing hypotension during neuraxial anaesthesia for Caesarean delivery is unclear. Although phenylephrine was recently recommended as a consensus choice, direct comparison of phenylephrine with vasopressors used in other healthcare settings is largely lacking. Therefore, we assessed this indirectly by collating data from relevant studies in this comprehensive network meta-analysis. Here, we provide the possible rank orders for these vasopressor agents in relation to clinically important fetal and maternal outcomes.

**Methods:** RCTs were independently searched in MEDLINE, Web of Science, Embase, The Cochrane Central Register of Controlled Trials, and [clinicaltrials.gov](http://clinicaltrials.gov) (updated January 31, 2019). The primary outcome assessed was umbilical arterial base excess. Secondary fetal outcomes were umbilical arterial pH and  $P_{CO_2}$ . Maternal outcomes were incidences of nausea, vomiting, and bradycardia.

**Results:** We included 52 RCTs with a total of 4126 patients. Our Bayesian network meta-analysis showed the likelihood that norepinephrine, metaraminol, and mephentermine had the lowest probability of adversely affecting the fetal acid-base status as assessed by their effect on umbilical arterial base excess (probability rank order: norepinephrine > mephentermine > metaraminol > phenylephrine > ephedrine). This rank order largely held true for umbilical arterial pH and  $P_{CO_2}$ . With the exception of maternal bradycardia, ephedrine had the highest probability of being the worst agent for all assessed outcomes. Because of the inherent imprecision when collating direct/indirect comparisons, the rank orders suggested are possibilities rather than absolute ranks.

**Conclusion:** Our analysis suggests the possibility that norepinephrine and metaraminol are less likely than phenylephrine to be associated with adverse fetal acid-base status during Caesarean delivery. Our results, therefore, lay the scientific foundation for focused trials to enable direct comparisons between these agents and phenylephrine.

**Keywords:** Caesarean section, fetal outcomes; maternal outcomes, hypotension; network meta-analysis, vasopressors; spinal anaesthesia

### Editor's key points

- The results suggest that norepinephrine, metaraminol, and mephentermine have the smallest risk of adversely affecting fetal acid-base status, and ephedrine had the greatest risk.
- This grading of risk between vasopressors largely held true for umbilical arterial pH and  $P_{CO_2}$ . With the exception of maternal bradycardia, ephedrine had the highest probability of being the worst agent for all assessed outcomes.

norepinephrine > mephentermine > metaraminol > phenylephrine > ephedrine

## REVIEW ARTICLE

## Vasopressor drugs for the prevention and treatment of hypotension during neuraxial anaesthesia for Caesarean delivery: a Bayesian network meta-analysis of fetal and maternal outcomes

Preet M. Singh<sup>1,\*</sup>, Narinder P. Singh<sup>2</sup>, Matthew Reschke<sup>3</sup>, Warwick D. Ngan Kee<sup>4</sup>, Arvind Palanisamy<sup>1</sup> and David T. Monks<sup>1</sup>

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umbilikální pH

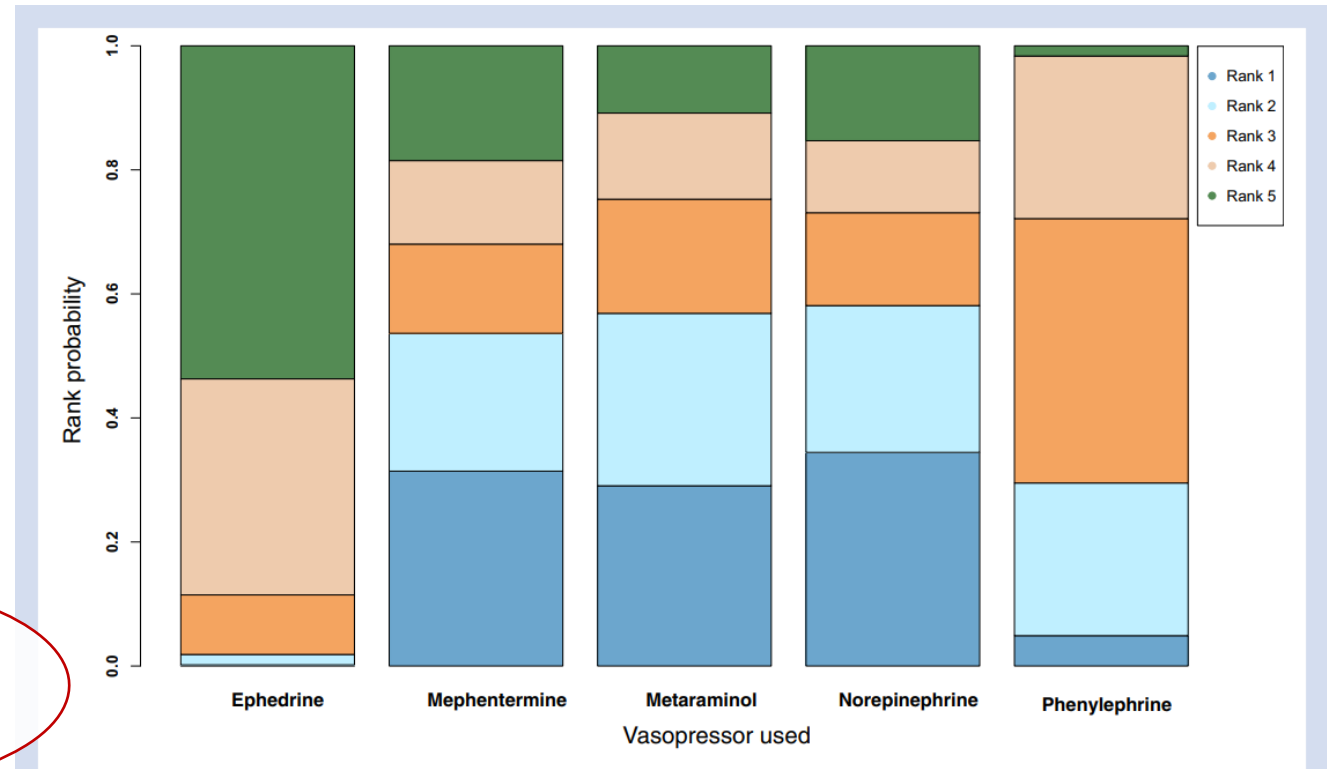


Fig 3. Umbilical artery base excess rankogram showing the rank probability for each of the treatment groups for umbilical artery base excess. Each treatment group has probability varying from 0 to 1 to fall within ranks 1 (best) to 5 (worst). The coloured segments in the bars represent the probability of the treatment falling under the given rank for the colour shown. The lower the rank, the better the treatment.

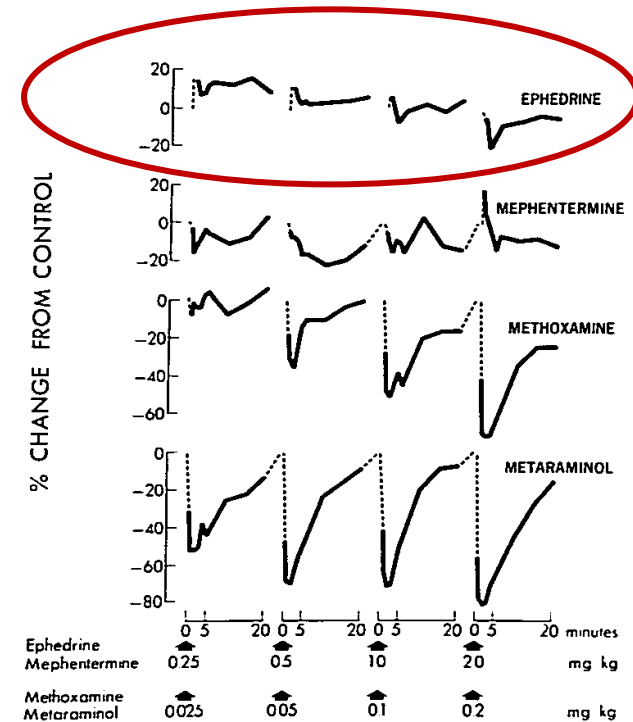
norepinephrine > mephentermine > metaraminol > phenylephrine > ephedrine

# Effects of Equipotent Ephedrine, Metaraminol, Mephentermine, and Methoxamine on Uterine Blood Flow in the Pregnant Ewe

David H. Ralston, M.D.,\* Sol M. Shnider, M.D.,† Alfred A. deLorimier, M.D.‡

To evaluate the safety of prophylactic vasopressor administration prior to obstetric conduction anesthesia, equipotent doses of ephedrine, metaraminol, mephentermine, and methoxamine were administered to 16 nonanesthetized pregnant ewes near term. When the maternal blood pressure was increased by 50 per cent, uterine blood flow was unchanged with ephedrine and was reduced 20 per cent with mephentermine ( $P > 0.05$ ); 45 per cent with metaraminol ( $P < 0.05$ ) and 62 per cent with methoxamine ( $P < 0.05$ ). Metaraminol and methoxamine consistently decreased uterine blood flow at all levels of maternal blood pressure elevation. No significant change in fetal blood gas and acid-base variables was demonstrated. (Key words: Sympathetic nervous system: sympathomimetic agents: uterine blood flow; Uterus, blood flow: sympathomimetic agents; Anesthesia, obstetric: uterine blood flow.)

FIG. 3. Mean changes in uterine blood flow following intravenous administration of each vasopressor dose. Number of experiments for each dose and standard error for changes from control are given in tables 1-4.



# Guidelines

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International consensus statement on the management of hypotension with vasopressors during caesarean section under spinal anaesthesia

S. M. Kinsella,<sup>1</sup> B. Carvalho,<sup>2</sup> R. A. Dyer,<sup>3</sup> R. Fernando,<sup>4</sup> N. McDonnell,<sup>5</sup> F. J. Mercier,<sup>6</sup> A. Palanisamy,<sup>7</sup> A. T. H. Sia,<sup>8</sup> M. Van de Velde<sup>9,10</sup> and A. Vercueil<sup>11</sup>

## Recommendations for best clinical practice

- 1 Hypotension following spinal or combined spinal-epidural anaesthesia at caesarean section causes both maternal and fetal/neonatal adverse effects.
- 2 Hypotension is frequent and, therefore, vasopressors should be used routinely and preferably prophylactically.
- 3  $\alpha$ -agonist drugs are the most appropriate agents to treat or prevent hypotension following spinal anaesthesia. Although those with a small amount of  $\beta$ -agonist activity may have the best profile (noradrenaline (norepinephrine), metaraminol), phenylephrine is currently recommended due to the amount of supporting data. Single-dilution techniques, and/or prefilled syringes should be considered.
- 4 Left lateral uterine displacement and intravenous (i.v.) colloid pre-loading or crystalloid coload, should be used in addition to vasopressors.

**vasopresory rutinně a profylakticky**

**alfa-agonisté první volbou = phenylephrin**

**prevence aorto-kavální komprese  
a koloidní preload/ krystaloidní koload**

**ale nejlepší profil mají  
 $\alpha$ -agonisté s malou  $\beta$  aktivitou:  
metaraminol, noradrenalin**

Table 1 Comparison of commonly used vasopressors.

	Ephedrine	Phenylephrine	Metaraminol	Noradrenaline	Adrenaline
<b>Receptor</b>	$\beta$ 1, $\beta$ 2, weak $\alpha$	$\alpha$ 1	$\alpha$ 1, weak $\beta$	$\alpha$ 1, $\beta$	$\alpha$ 1, $\beta$
<b>Mechanism</b>	Indirect, weak direct	Direct	Direct and indirect	Direct	Direct
<b>Onset</b>	Slow	Immediate	1–2 min	Immediate	Immediate
<b>Duration</b>	Prolonged	Intermediate	Prolonged	Short	Short

Techniques for preventing hypotension during spinal anaesthesia for caesarean section (Review)

Chooi C, Cox JJ, Lumb RS, Middleton P, Chemali M, Emmett RS, Simmons SW, Cyna AM

Cochrane Database of Systematic Reviews 2020, Issue 7. Art. No.: CD002251.

DOI: 10.1002/14651858.CD002251.pub4.

Analysis 7.1. Comparison 7: Colloid vs crystalloid, Outcome 1: Women with hypotension requiring intervention

koloidy vs. krystaloidy

Study or Subgroup	Colloid		Crystalloid		Weight	Risk Ratio	Risk Ratio
	Events	Total	Events	Total		M-H, Random, 95% CI	M-H, Random, 95% CI
Alimian 2014	4	30	26	60	2.0%	0.31 [0.12, 0.80]	
Arora 2015 (1)	11	30	20	30	3.7%	0.55 [0.32, 0.94]	
Böttiger 2010	3	32	5	28	1.2%	0.53 [0.14, 2.00]	
Bouchnak 2012	12	30	22	30	3.9%	0.55 [0.33, 0.89]	
Cardoso 2004	25	25	25	25	5.9%	1.00 [0.93, 1.08]	
Dahlgren 2007	37	56	45	53	5.4%	0.78 [0.62, 0.97]	
El-Mekawy 2012	17	28	19	25	4.6%	0.80 [0.55, 1.16]	
Embu 2011	9	30	12	30	2.9%	0.75 [0.37, 1.51]	
French 1999	8	25	11	25	2.8%	0.73 [0.35, 1.50]	
Gunaydin 2009	10	80	38	80	3.3%	0.26 [0.14, 0.49]	
Hasan 2012	24	30	25	30	5.3%	0.96 [0.76, 1.22]	
Jabalarneli 2011	6	30	14	30	2.5%	0.43 [0.19, 0.96]	
Karinen 1995	32	50	27	50	4.8%	1.19 [0.85, 1.65]	
Karinen 1995	5	13	8	13	2.5%	0.63 [0.28, 1.41]	
Lin 1999	8	30	16	30	3.0%	0.50 [0.25, 0.99]	
Madi-Jebara 2008	39	61	48	59	5.4%	0.79 [0.63, 0.98]	
Mercier 2014	30	82	47	85	4.8%	0.66 [0.47, 0.93]	
Ozkan 2004	24	75	31	75	4.3%	0.77 [0.51, 1.19]	
Perumal 2004	13	20	14	20	4.3%	0.93 [0.60, 1.43]	
Romdhani 2014	33	48	46	53	5.4%	0.79 [0.64, 0.98]	
Selvan 2004	20	40	14	20	4.3%	0.71 [0.47, 1.09]	
Siddik 2000	8	20	16	20	3.5%	0.50 [0.28, 0.89]	
Singh 2009	0	30	0	30		Not estimable	
Ueyama 1999	10	24	9	12	3.5%	0.56 [0.31, 0.99]	
Unlugenc 2015	6	30	13	30	2.4%	0.46 [0.20, 1.05]	
Upadya 2016	7	25	20	25	3.1%	0.35 [0.18, 0.68]	
Yorozu 2002	27	32	26	35	5.3%	1.14 [0.89, 1.45]	

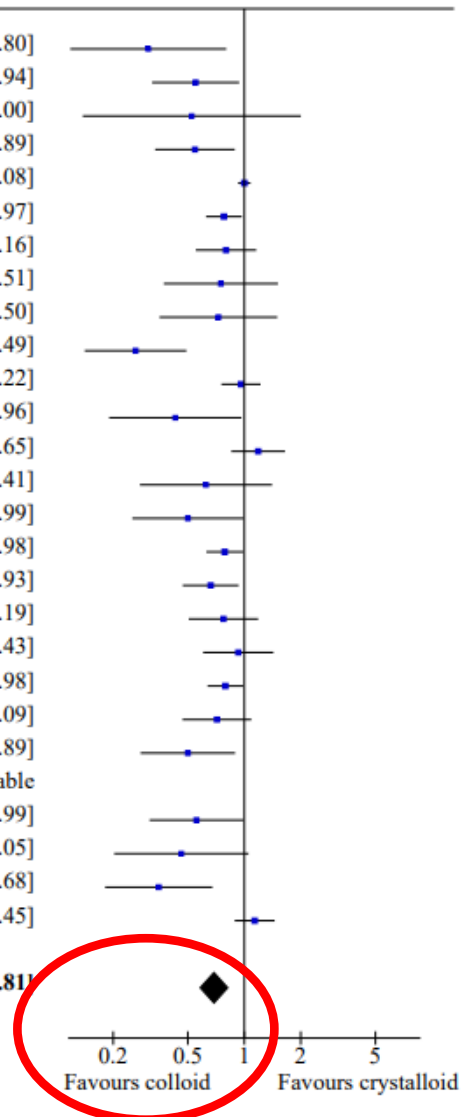
Total (95% CI) 1006 1003 100.0% 0.69 [0.58, 0.81]

Total events: 428 597

Heterogeneity: Tau<sup>2</sup> = 0.12; Chi<sup>2</sup> = 140.36, df = 25 (P < 0.00001); I<sup>2</sup> = 82%

Test for overall effect: Z = 4.37 (P < 0.0001)

Test for subgroup differences: Not applicable



RESEARCH ARTICLE

# Leg elevation decreases the incidence of post-spinal hypotension in cesarean section: a randomized controlled trial

Ahmed Hasanin<sup>1</sup>, Ahmed Aiyad<sup>1</sup>, Ahmed Elsakka<sup>1</sup>, Atef Kamel<sup>1</sup>, Reham Fouad<sup>2</sup>, Mohamed Osman<sup>1</sup>, Sherin Refaat<sup>1</sup> and Yasmin Hassabelnaby<sup>1\*</sup>

**Abstract**

**Background:** Maternal hypotension is a common complication after spinal anesthesia for cesarean section (CS). In this study we investigated the role of leg elevation (LE) as a method for prevention of post-spinal hypotension (PSH) for cesarean section.

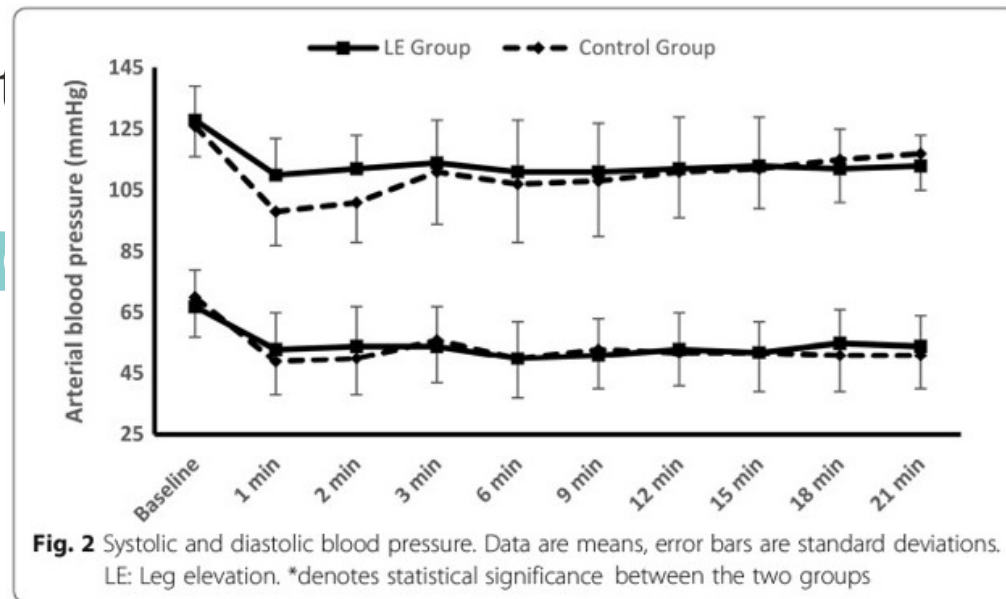
**Methods:** One hundred and fifty full term parturients scheduled for CS were included in the study. Patients were randomized into two groups: Group LE (leg elevation group,  $n = 75$ ) and group C (Control group,  $n = 75$ ). Spinal block was performed in sitting position after administration of 10 mL/Kg Ringer's lactate as fluid preload. After successful intrathecal injection of local anesthetic, Patients were positioned in the supine position. Leg elevation was performed for LE group directly after spinal anesthesia and maintained till skin incision. Intraoperative hemodynamic parameters (Arterial blood pressure and heart rate), intra-operative ephedrine consumption, incidence of PSH, and incidence of nausea and vomiting were reported.

**Results:** LE group showed lower incidence of PSH (34.7% Vs 58.7%,  $P = 0.005$ ) compared to the control group. Arterial blood pressure was higher in the LE group compared to the control group in the first two readings after spinal block. Other readings showed comparable arterial blood pressure and heart rate values between both study groups; however, LE showed less ephedrine consumption ( $4.9 \pm 7.8$  mg Vs  $10 \pm 11$  mg,  $P = 0.001$ ).

**Conclusion:** LE performed immediately after spinal block reduced the incidence of PSH in parturients undergoing CS.

**Trial registration:** The study was registered at Pan African Clinical Trials Registry system on 5/10/2015 with trial number PACTR201510001295348.

**Keywords:** Hypotension, Spinal anesthesia, Cesarean section, Leg elevation



**Table 1** Demographic data and patients' outcomes

	LE group ( $n = 75$ )	Control group ( $n = 75$ )	<i>P</i> value
Age (years)	$29 \pm 4$	$30 \pm 4$	0.13
Weight (Kg)	$69 \pm 7$	$72 \pm 8$	0.02*
Total infused volume (mL)	$1790 \pm 408$	$1865 \pm 450$	0.29
Urine output (mL)	$570 \pm 90$	$590 \pm 69$	0.12
Incidence of hypotension	26(34.7%)	44(58.7%)	0.005*
Ephedrine consumption (mg)	$4.9 \pm 7.8$	$10 \pm 11$	0.001*
Nausea & vomiting	8(10.7%)	14(18.7%)	0.24
Incidence of bradycardia	4(5.3%)	7(9.3%)	0.53

LE leg elevation, SAB subarachnoid block, NS not significant

\*denotes statistical significance ( $P$  value  $< 0.05$ )

Data are presented as mean  $\pm$  standard deviation and frequency (%)

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