Impact of cafedrine/theodrenaline (Akrinor®) on therapy of maternal hypotension during spinal anesthesia for Cesarean delivery: a retrospective study

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Aim. **Maternal hypotension is the most frequent complication in spinal anesthesia for Cesarean delivery. Malperfusion of the foetus and nausea and vomiting of the mother are hallmarks of maternal hypotension. In this retrospective data analysis and anesthesia protocols we have investigated to explore the effects of therapeutic interventions for hypotension with cafedrine/theodrenaline (Akrinor®) during spinal anesthesia for elective Cesarean section.**

Methods. **In a retrospective study anesthesia charts of 173 parturients undergoing spinal anesthesia for Cesarean delivery with 10mg hyperbaric bupivacaine + 5 µg sufentanil were reviewed for 30 min after onset of hypotension with respect to blood pressure, heart rate, respiration rate, as well as APGAR scores and umbilical arterial pH. Maternal data were compared to baseline values recorded and documented immediately before placing the spinal anesthesia in the operating room. The cohort was divided into two groups according to their hemodynamic response to spinal anesthesia: 117 parturients had a drop of systolic blood pressure to <120 mmHg or <80% of baseline blood pressure and were therefore treated with Akrinor® (cafedrine/theodrenaline; treatment group); 56 patients remained within the specified limits (non-treatment group). Maternal cardiovascular parameters and newborn outcome between the groups were compared.**

Results. **Both groups were comparable with regard to baseline characteristics. In the treatment group one minute after the first application of cafedrine (43 mg)/theodrenaline (2.2 mg) mean systolic blood pressure raised from 108.6 mmHg to 117.2 mmHg (P=0.0004), mean of maximal changes of systolic blood pressure after the first application of Akrinor® was 21.3 mmHg. Blood pressure levels of the non-treatment group were regained in the treatment group 8 min after hypotension onset and remained at that level until the end of 30 min observation. No clinically relevant changes of heart rate were detectable. While mean APGAR score one minute post partum was significantly higher in the treatment group (8.9±1.2 *vs.* 8.4±1.1 P=0.043), mean umbilical arterial cord pH was 7.3±0.1 and APGAR scores 5 and 10 minutes postpartum did not differ significantly.**

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Conclusion. **The results of this study confirm a rapid and sustained increase in blood pressure after application of Akrinor® for treatment of sympathicolysis induced hypotension. No negative impact of Akrinor® on umbilical arterial cord pH and APGAR scores was observed.**

Spinal anesthesia offers a fast, profound, and high quality sensory and motor block associated with a sympathetic block in parturients undergoing Cesarean delivery.[1] The most common complication of spinal anesthesia for Cesarean delivery due to sympathetic block is maternal hypotension, with a reported incidence greater than 80%.[2] Hemodynamic changes during spinal/regional anesthesia are due to a preganglionic block of sympathetic fibers in the subarachnoidal and epidural space.[3]

Maternal hypotension may have detrimental effects on both mother and neonate; these effects include decrease of utero-placental blood flow, impaired fetal oxygenation with asphyxia stress and fetal acidosis. Further, worse neonatal outcome as measured by umbilical artery pH and APGAR scores has been reported under these conditions.[4, 5] Additionally, maternal symptoms of low cardiac output and hypotension, such as nausea, vomiting, dizziness, and decreased consciousness are common.[2, 4]

Lateral uterine displacement and intravenous prehydration are commonly used to prevent hypotension but these have limited efficacy and a vasopressor drug is often required.[2, 6] Besides the extremely short acting drugs epinephrine, norepinephrine, dobutamine and dopamine in Germany merely cafedrine/theodrenaline (Akrinor®) and amezinium methylsulfate are approved for intravenous therapy of hypotension. While etilefrine increases cardiac output and systemic vascular resistance *via* stimulation of alpha and beta adrenoreceptors, cafedrine/theodrenaline exerts its supportive effect on cardiac output and blood pressure *via* beta receptors and increase of cAMP without increased systemic vascular resistance.[7, 8] After application of etilefrine a drop in uterine blood flow has been shown.[9, 10] Data on the effects of cafedrine/theodrenaline in parturients are lacking, however, animal experiments indicate no relevant changes in uterine blood flow. To which extent the condition of the newborn is affected by cafedrine/theodrenaline administered for the treatment of maternal hypotension during spinal anesthesia for Cesarean delivery has not yet been investigated.

The purpose of the retrospective data analysis was to explore the effects and consequences of cafedrine/theodrenaline (Akrinor®) for treatment of maternal hypotension during spinal anesthesia for Cesarean delivery, as well as neonatal outcome, including umbilical artery pH.

Materials and methods

In a retrospective study standard documented data of 173 healthy women undergoing elective spinal anesthesia for Cesarean delivery between November 2001 and August 2005 were analyzed. Pre-eclamptic or hypertensive women were not included. Parturients who received a minimum of one intravenous application cafedrine/theodrenaline were included. Documented demographic data were compared. Standard monitoring consisted of automated oscillometric blood pressure measurements, oxygen saturation and 3 lead ECG. Maternal data were compared to baseline values, recorded and documented immediately before placing the spinal anesthesia in the operating room. During the initial 10 minutes after subarachnoidal block blood pressure was measured in one minute intervals, thereafter every five minutes until the end of a 30 min observation period.

The included patients in this retrospective study were divided in two groups according to their hemodynamic response to spinal anesthesia. After onset of subarachnoid block 117 parturients had a drop of systolic blood pressure to <120 mmHg or

<80% of baseline blood pressure (hypotensive group) and were therefore treated with Akrinor®. 56 patients remained within the specified limits and served as control group.

Occurrence of maternal symptoms such as nausea, vomiting, dizziness, and decreased consciousness were categorized as either absent or existing. Newborn outcome was measured by umbilical artery pH and APGAR Scores. Duration of Cesarean sections was, likewise, documented. Duration of delivery was defined as the time period between spinal injection and the end of section of the umbilical cord. Furthermore, doses, number of repetitive administrations and time points of applications of Akrinor® were analyzed.

Spinal technique

Spinal anesthesia was performed in a standardized manner in sitting position using 10 mg hyperbaric bupivacaine with 5 µg sufentanil. The height of neural blockade was measured by sensory level to cold, using ethyl chloride spray at 5 and 10 minutes postspinal and at skin incision. The target block height was above T5. Before spinal anesthesia, a preload of 500 mL hydroxyethyl starch (hetastarch) 10% was rapidly infused.

Antihypotensive medication

Two ml of Akrinor® contain 200 mg cafedrine hydrochloride and 10 mg of theodrenaline hydrochloride. According to our standard regimen, 2 mL Akrinor® (one ampoule) were diluted to a total of 10 mL with sodium chloride 0.9% for IV application. The dose calculations were based on the cafedrine component. After administration of the local anesthetic Akrinor® was given immediately when the hemodynamic criteria were fulfilled as stated. The dosage was chosen according to the severity of hypotension, expecting an effective dose (ED 50) in females for a 10% increase in mean arterial blood pressure (MAP) within 5 min with a dose of 1.0 mg/kg theodrenaline (+50 µg/kg cafedrine).[11] The number of repeated administrations was dependent on the clinical situation with regard to the described criteria and individual drug efficacy.

TABLE I.—*Patient and Cesarean section related data (mean±SD, percent), in the non-treatment and treatment group.*

	Non-treatment group (N.=56)	Treatment group (N.=117)	P value
Age (years)	29.5±9.1	30.6±8.1	N.S..
Gemini pregnancy	2%	6%	
Blood pressure (mmHg) b.v.*	139/68±16	134/65±16	N.S.
Heart rate (1/min) b.v.	93±19	97±19	N.S.
Respiration (1/min) b.v.	18±6	17±5	N.S.
Oxygen saturation (%) b.v.	99±1	99±1	N.S.
Spinal bupivacaine (mg)	10±0	10±0	N.S.
Spinal sufentanil (µg)	6±2	5±1	0.04
Level of sensory blockade (dermat.)	Th 7±2	Th 6±2	N.S.
Duration of surgery (min)	40±12	42±15	N.S.
Daytime (h)	12 a.m.±5	12 a.m.±4	N.S.

*b.v.: baseline value.

Data analysis and statistics

All data derived from the charts were anonymized and transferred to an MS-Excel database. Descriptive statistics was calculated by the statistic institute "Advanced Medical Services" GmbH, Mannheim, Germany (AMS). Data were transferred to the SAS 9.1.3 software and calculated according to the predefined statistical analysis plan. The data were analyzed descriptively (mean±SD) for arterial blood pressure and heart rate, respectively. The mean arterial blood pressure was calculated as MAP=dia + (sys-dia)/3. Further inference statistics and multivariate analysis were calculated by using SPSS software (SPSS 17.0 for windows).

Comparative group analyses of single measurements were performed by using the two- tailed Student's t-test. Repeated

TABLE II.—*Compilation of Psyst and MAP in absolute values (mean±SD) and changes in comparison to baseline (absolute and relative) dependent on time post administration (p.a.) after the first and second administration, respectively.*

Akrinor® administration	Time p.a. (min	N.	P_{syst}		MAP		Significance level*
			Mean±SD [mmHg]	Change Mean±SD (mmHg) (%)	Mean±SD (mmHg)	Change Mean±SD (mmHg) (%)	
1st	0	112	108.6±21.4		72.2±14.6		
	2	62	127.5±19.6	17±21.1 (18)	83.0±13.1	8.1±16 (14.2)	P<0.01
	3	56	126.1±19.5	15.9±23.8 (17.8)	80.9±12.0	6.6±17.5 (13.4)	P<0.05
2nd	1	55	116.4± 21.4	11.1±18.6 (11.8)	76.6±20.8	8.8±20.6 (15.4)	P<0.01
	3	28	131.9± 14.1	22.5±20.3 (23.4)	85.1±12.7	15.3±12.1 (24.1)	P<0.01

*Valid for Psyst and MAP, respectively.

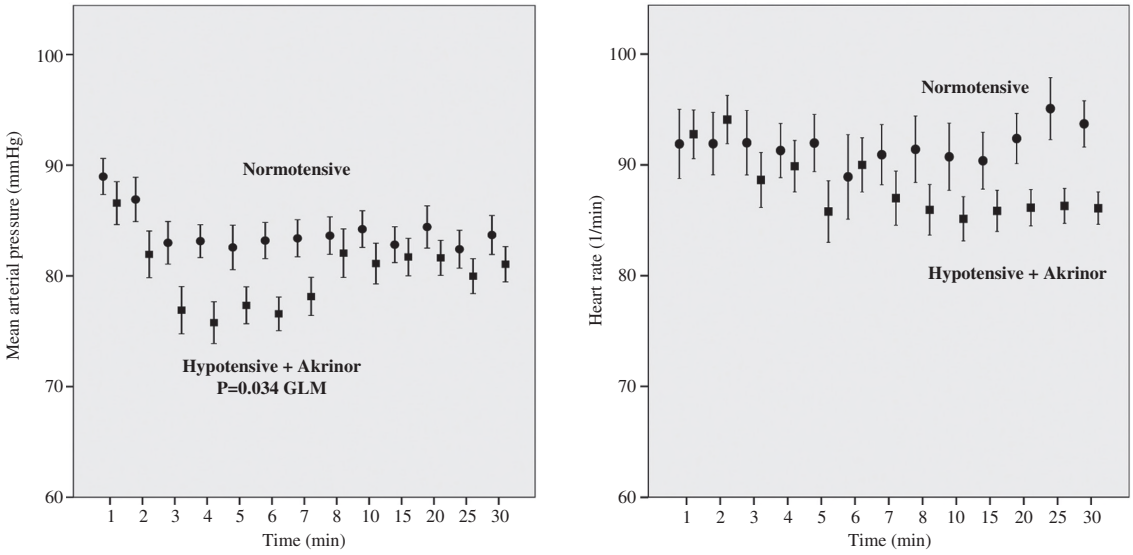

Figure 1.—Mean arterial pressure (mean±SEM) (left) and heart rate (right) in parturients undergoing Cesarean section in spinal anesthesia after administration of Akrinor® in the treatment group (N.=117; squares) and in the non-treatment group (N.=56; circles).

measurement analysis within and between groups was achieved with general linear model (GLM) according to a two- way ANOVA. Correction for *post hoc* multiple comparisons was performed with Bonferroni procedure.

To identify independent factors affecting outcome variables, such as APGAR score [5] or nausea, multifactorial regression models were established. In preparation of the data univariate statistics were compiled, to explain the distribution of both, dependent and independent variables. Bivariate analysis of independent variables was calculated against outcome variables, ensuring linearity, normal distribution, and equal variances. Pairs of independent variables correlating >0.8 in a correlation matrix (multicolinearity) were identified and one of the two parameters was dropped. The variance inflation factor served as control parameter (in all cases <1.7). Multiple linear regression models were fitted for the quantitative outcome variables APGAR, umbilical chord

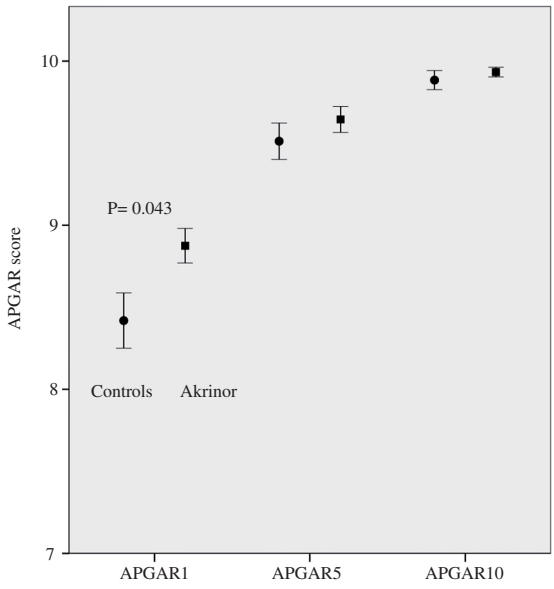

Figure 2.—APGAR scores (mean±SEM) after 1, 5, and 10 minutes post partum in the non-treatment group (circles) and the treatment group (squares). Overall GLM p=0.078

pH, and nausea. Optimal fitted regression models were found by stepwise forward selections. The end model fit was checked by analysis of residuals in quantile-quantile plots for normal distribution. The following co-variables uniformly stood for the selection in regression models: MAP baseline, percent drop MAP, absolute dosage of Akrinor® per injection and volume given before fall of blood pressure. Only optimal end models and their certainty coefficients are shown.

All P values cited were two-sided and P values <0.05 were considered statistically significant. Any increases <5 mmHg were not included in the analysis of maximal increase of blood pressure.

Results

Patient characteristics

The data sheets of all 173 parturients were eligible for analysis. Demographic data can be obtained from Table I. The physical conditions of the patients were ASA I-II. Fifty-six percent of the newborns were male. Mean duration of recording and documentation of vital functions was 25.0±1.0 minutes.

TABLE III.—*Regression model for predicting APGAR 10 minutes post partum after Cesarean section under spinal anesthesia R^2=0.23.*

	Non-standardized beta coefficients	Standardized beta coefficients	P value
Constant	9.989		0.001
Akrinor® dose	0.061	0.421	0.019
Age	-0.013	-0.349	0.048

Akrinor® dosing

There were 2.1[range 1-6] Akrinor® administrations with a mean of 89±51 mg cafedrine/4.4±2.6 mg theodrenaline per case. The mean initial doses administered were 43±11 mg cafedrine/2.2±0.6 mg theodrenaline. First application was given 4.0±3.0 minutes (1.0-20.0 minutes) after onset of subarachnoid block. The interval between the first and second Akrinor® administration was in mean 3 minutes with a range of 1 to 29 minutes.

Mean arterial blood pressure as well as heart rate measurements are presented in Figure 1 and Table II. As depicted the onset of Akrinor® effect can be expected within two to three minutes. Eight minutes after start of the hypotensive phase sustained blood pressure levels comparable to the normotensive group were regained in the treatment group. Furthermore, 49.6%, 37%, and 46.7% of the patients reached maximum blood pressure as early as one minute after the first, second and third application of Akrinor®, respectively. Respiration and oxygen saturation kept stable over time in the non-treatment group (18±2/min; 99.1±0.1%) and in the treatment group (17±1/min; 99±0.1%). No differences within or between the groups were observed in heart rate, respiration rate or oxygen saturation.

APGAR scores were significantly higher 1 minute postpartum in the treatment group (Figure 2) compared to the non-treatment

TABLE IV.—*Side effects (percent), pain and patient satisfaction scores (mean±SD) in both groups.*

	Non-standardized beta coefficients	Standardized beta coefficients	P value
Nausea	9.4%	24.4%	0.024
Vomiting	3.8%	5.9%	N.S.
Pruritus	11.3%	4.2%	N.S.
Tiredness	7.5%	6.7%	N.S.
Shivering	13.2%	10.9%	N.S.
Satisfaction	1.2±0.4	1.3±0.5	N.S.
Pain scores	0.5±0.1	0.6±0.1	N.S.

Pain scores are reported on a numeric rating scale (from 0=no pain to 10=most severe pain) and patient satisfaction on a numeric rating scale (from 1=excellent to 6=very poor).

group. The overall effect for all three APGAR time points, however, slightly missed statistical significance (P=0.078). Multivariable analysis revealed higher Akrinor® dose and lower age of the mother as predictive for a higher APGAR score 10 min postpartum (Table III*)*. There was no significant difference in umbilical artery pH between the groups (non-treatment group 7.32±0.05 *vs*. treatment group 7.31±0.06).

Side effects

During Cesarean delivery side effects were recorded as shown in Table IV. Pain scores were measured on a numeric rating scale (0=no pain to 10=most severe pain) and patient satisfaction on a numeric rating scale (1=excellent to 6=very poor). Scores showed no differences between the groups. While hypotension and Akrinor® administration are systematically coupled no conclusion can be drawn which of both is the underlying factor for significantly elevated incidence of nausea in this group. Predictive factors for nausea from a multivariable regression analysis are given in Table V. Except the sufentanil dose which is inversely correlated with the incidence of nausea, all displayed factors favor nausea because of their direct correlation. The relative impact of each factor can be estimated regarding the absolute value of the respective standardized beta coefficients.

TABLE V.—*Regression model for predicting nausea in parturients undergoing Cesarean section in spinal anesthesia R^2=0.72. The independent factors are sorted in descending order of impact on the dependent factor nausea.*

	Non-standardized beta coefficients	Standardized beta coefficients	P value
Constant	-2.158		0.001
Akrinor® dose	0.06	0.435	0.001
Systolic blood pressure baseline	0.009	0.403	0.006
Pain intensity baseline	0.164	0.313	0.012
Bupivacain dose	0.752	0.282	0.038
Daytime	7.39E-06	0.271	0.03
Sufentanil dose	-0.12	-0.252	0.045

Discussion

Anesthetic interventions that are performed during pregnancy or child delivery must ensure adequate maternal arterial pressure maintaining appropriate utero-placental perfusion.

Despite volume substitution and left tilt position of the parturient during spinal anesthesia a high incidence of maternal hypotension of 17% to 85% has been reported, dependent on the definition of hypotension.[12, 13] Hypotension is caused by a reduction of systemic vascular resistance due to sympathicolysis and venous pooling followed by decrease in cardiac preload and subsequent drop of cardiac output. Whereas crystalloid solutions have less sustained intravascular volume effect, colloid solutions are frequently used to prevent hypotension,[14] even though this measure may not be sufficient in all cases. In clinical practice, vasopressors are used for therapy of hypotension and its prevention prior to sympathicolysis, because a few minutes of maternal hypotension alone may lead to fetal acidosis.[15]

For some time, vasopressors with both α- and β-mimetic properties (*e.g.*, ephedrine and phenylephrine) were the substances of choice for treatment of hypotension, *e.g.*

in spinal anesthesia and Cesarean section. They have a stimulating effect on cardiac output and hence stabilize utero-placental perfusion in addition to the well known systemic vasoconstrictive effect. Of these substances, ephedrine was the drug of choice. Low- dose ephedrine increases the maternal arterial pressure without adverse effects on utero-placental perfusion; however, fetal acidosis, still, was observed.[16, 17] On the other hand, a meta-analysis showed better newborn outcome for use of phenylephrine, as compared to ephedrine despite theoretical disadvantages of sole administration of an alpha receptor agonist.[18] These results recharged the debate about the most appropriate vasopressor. Furthermore, a decrease of uterine blood flow has been found after administration of etilefrine in animal experiments and in humans.[9, 10] Therefore, a gold standard of a vasopressor which is safe for both mother and newborn has not yet been established.

However, phenylephrine and ephedrine have no marketing authorisation for Germany. The most frequently used vasoactive substance in Germany is Akrinor®. Akrinor® increases cardiac output and arterial blood pressure by stimulation of β-receptors and shows some effect on cyclic adenosine monophosphate without increase of the systemic vascular resistance as under stimulation of alpha-adrenoreceptors.[7, 8] Akrinor® is frequently used in Germany to restore arterial pressure in different forms of anesthesiology and also during pregnancy, but only little is known about its effect on utero-placental perfusion and fetal gas exchange in humans. Apart from two experimental studies in pregnant sheep, Akrinor® has hardly been investigated in clinical trials with patients undergoing Cesarean section.[19, 20]

The statistical significant difference of 1 µg sufentanil, as shown in Table I, must be considered clinically irrelevant, because it originates from six patients in the non-treatment and two patients in the treatment group who received 10 µg sufentanil each. Reported pain scores and patient satisfaction with Cesarean section showed good results.

As main finding of this study present data clearly demonstrates, that the overall APGAR score after a hypotensive episode treated with cafedrine/theodrenaline was not inferior to the overall APGAR score in the non-treatment group. On the opposite, overall APGAR improvement after Akrinor® slightly escaped a level of statistical significance (Figure 2). Furthermore, no difference in umbilical artery pH between these two groups was detectable. It has to be taken into consideration that the two groups are different in their hemodynamic response to spinal anesthesia. The assignment to the treatment group is the consequence of an arterial hypotension. Despite these different underlying conditions the outcome for the newborn with respect to APGAR score and pH-value in umbilical artery was identical, and even improved in the initial phase. Multivariable analysis (Table III) shows that increasing the Akrinor® dose is correlated with higher APGAR scores 10 min postpartum.

A comparative experimental investigation of Akrinor® with ephedrine and ethylephrine, respectively, in normotonic and hypotonic sheep showed differences in the duration of effects.[19, 20] However, a negative effect could not be ruled out for Akrinor® but was not seen for the comparator drugs on utero-placental perfusion in normotensive sheep.[19] Further, it was also shown that the arterial pressure was not predictive for the states of utero-placental perfusion. On the other hand, an extrapolation of the Akrinor® effects from these animal models to humans was limited due to a later onset of the increase of blood pressure, an increase of heart rate and the observation of acidosis in sheep but not in man. In principle, multiple factors may influence acid-base-status, APGAR score and, therefore, newborn outcome, including prolonged child birth (parturition), acute or persistent placental dysfunction, maternal factors such as diabetes mellitus and others.

According to the results of this retrospective study Akrinor® proved effective in restoring maternal blood pressure for treatment of hypotension, induced by sub-

arachnoid application of bupivacaine/sufentanil, without relevant effects on heart rate. Akrinor®, which is routinely used in obstetrics in Germany [21] has shown to be an effective drug for restoring blood pressure and its use was not associated with worse neonatal outcome. Side effects did not significantly differ between the groups (Table IV). A higher proportion of nausea in the treatment group can not, however, directly be assigned to Akrinor® because hypotension and Akrinor® administration are systematically coupled. Thus, no conclusion can be drawn which of both, Akrinor® administration or hypotension, is the underlying factor for significantly elevated incidence of nausea. A prospective randomized placebo controlled study would be able to distinguish between the underlying factors hypotension and antihypotensive treatment for nausea; however, such study design would not be ethically acceptable. Increased nausea in the treatment group more likely reflects the impact of varying blood pressure levels on the area postrema. In this regard, higher baseline blood pressure indicated higher risk of nausea (Table V). Further, pain intensity, higher bupivacaine dose, and late daytime of delivery increased the likelihood of nausea. On the opposite, higher sufentanil doses protected from nausea.

When the parturient is correctly hydrated, the rapid use of intravenous cafedrine/theodrenaline is efficient in restoring normal maternal arterial pressure and has no deleterious effect on the fetus and the newborn with regard to APGAR scores. Finally, repetitive and non-invasive monitoring of maternal arterial blood pressure is the prerequisite to a timely management of maternal hypotension, which is essential to avoid deleterious effects to the fetus and the neonate, respectively.

Study limitations

Research in obstetrical anesthesia is limited because of ethical reasons, resulting in a considerable lack of clinically applicable data from prospective trials in humans. The present retrospective study design of statistical control for confounding effects is, thus, appropriate to draw conclusions on the effects of Akrinor® in the specified treatment group. This is particularly so because of the detailed standardized documentation that has been used since the introduction of spinal anesthesia for elective Cesarean delivery at our department.

There are several limitations to the presented study. Measurement of maternal uterine blood flow and perfusion were not possible. Furthermore, the absence of comparison groups for other vasopressors represents another important limitation of this study. Nevertheless, in the absence of a large multi-centered trial on this issue, we believe that the findings of this study are robust, as there was an adequate increase in maternal mean arterial blood pressure and no evidence for association of augmented fetal acidosis in newborns.

Conclusions

Altogether, the results of this retrospective data analysis show a rapid and significant increase in systolic blood pressure after administration of Akrinor® without a reduction of maternal heart rate or APGAR status of the newborn. Hypotension during spinal anesthesia for Cesarean section must be systematically detected, prevented and treated without delay. However, maternal hypotension is not always preventable and the use of vasopressors is still frequently required.

Riassunto

Impatto della cafedrina/teodrenalina (Akrinor®) sulla terapia dell'ipotensione materna durante anestesia spinale per parto cesareo: studio retrospettivo

Obiettivo. L'ipotensione materna è la complicanza più frequente dell'anestesia spinale per parto cesareo. La mal perfusione del feto e la nausea e il vomito della madre sono segni di ipotensione materna. In questa analisi retrospettiva di dati relative ai protocolli di anestesia, gli autori hanno analizzato gli effetti di interventi terapeutici per l'ipotensione

con cafedrina/teodrenalina (Akrinor®) durante anestesia spinale per parto cesareo in elezione.

Metodi. In maniera retrospettiva sono state rivedute le cartelle di anestesia di 173 partorienti sottoposte a parto cesareo in anestesia spinale con bupivacaina iperbarica 10 mg e sufentanil 5 µg per 30 min dopo l'insorgenza di ipotensione, valutando la pressione arteriosa, la frequenza cardiaca, la frequenza respiratoria, come pure i punteggi di APGAR e il pH dell'arteria ombelicale. I dati materni sono stati confrontati con i valori basali riscontrati immediatamente prima dell'anestesia spinale in sala operatoria. La coorte di pazienti è stata suddivisa in due gruppi in base alla risposta emodinamica all'anestesia spinale: 117 partorienti hanno avuto una riduzione della pressione arteriosa sistolica <120 mmHg o <80% della pressione arteriosa basale e sono state quindi trattate con Akrinor® (cafedrina/teodrenalina; gruppo di trattamento); 56 pazienti sono rimaste entro i limiti di norma (gruppo non-trattamento). I parametri cardiovascolari materni e lo stato di salute del neonato sono stati confrontati tra i due gruppi.

Risultati. Entrambi i gruppi erano sovrapponibili in termini di caratteristiche di base. Nel gruppo di trattamento, un minuto dopo la prima somministrazione di cafedrina (43 mg)/teodrenalina (2,2 mg) la pressione arteriosa sistolica media è risalita da 108,6 mmHg a 117,2 mmHg (P=0,0004), la media dei cambiamenti massimali della pressione arteriosa sistolica dopo la prima somministrazione di Akrinor® è stata 21,3 mmHg. I livelli di pressione arteriosa del gruppo non-trattamento sono stati raggiunti nel gruppo trattamento 8 min dopo l'insorgenza dell'ipotensione e sono rimasti a quel livello fino alla fine dei 30 minuti di osservazione. Non è stata rilevata alcuna modificazione clinicamente rilevante della frequenza cardiaca. Sebbene il punteggio medio di APGAR un minuto dopo il parto fosse significativamente più alto nel gruppo trattamento (8,9±1,2 *vs.* 8,4±1,1 P=0;043), il pH medio dell'arteria ombelicale era 7,3±0,1 e i punteggi di APGAR 5 e 10 minuti postpartum non differivano in maniera statisticamente significativa.

Conclusioni. I risultati di questo studio confermano un rapido e costante incremento della pressione arteriosa dopo la somministrazione di Akrinor® per il trattamento dell'ipotensione indotta dalla simpaticolisi. Non è stato osservato alcun impatto negative dell'Akrinor® sul pH del cordone ombelicale e nei punteggi di APGAR.

Parole chiave: Ipotensione - Anestesia, spinale - Parto cesareo - Cafedrina, teodrenalina.

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