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Research Article

Prevention of Arterial Hypotension during Cesarean Section under Spinal Anesthesia: Trial of a Babynoradrenaline Protocol at the Owendo University Hospital Center (Gabon)

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Keywords

- Babynorepinephrine
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Abstract

Spinal anesthesia is a commonly used technique in cesarean section. This technique causes frequent maternal hypotension responsible for a reduction in placental perfusion rate causing fetal acidosis. Prophylactic vasopressor treatment is systematically recommended. Noradrenaline is today a molecule of choice. The objective of this work was to describe the benefit of using baby norepinephrine in the prevention of arterial hypotension in the context of cesarean section under spinal anesthesia.

Methodology: Through a prospective observational study, parturients undergoing a planned or relative emergency cesarean section under spinal anesthesia during this period were included. Norepinephrine was administered by slow venous infusion at a rate of 0.028 to 0.057, or 4 to 10 drops/minute.

Results: During the study period, 28 women were included. Their mean age was 30.1 ± 5.6. Scarred uterus (32%) and narrowed pelvis (25%) were the main indications. Parturients were classified according to the American Society of Anesthesia (ASA) as ASA1 in 82.1%. The systolic blood pressure recorded after the start of the babynorepinephrine infusion at the 1st minute, between the 5th and 15th minutes and between the 15th and 30th was respectively between 100 and 140 mmHg in 71.4%, 85.7 % and 96.4% cases. Heart rate remained normal throughout norepinephrine administration.

Conclusion: Low-dose norepinephrine ensures good hemodynamic stability perioperatively for cesarean section under spinal anesthesia.

INTRODUCTION

Spinal anesthesia is a technique commonly used to facilitate cesarean deliveries because it allows the mother to be awake during childbirth and avoids the risks associated with general anesthesia. This technique is responsible for sympathetic block and vasoplegia leading to frequent maternal arterial hypotension, the incidence of which is estimated at up to 70-80% outside of prophylactic treatment. This maternal arterial hypotension may be poorly tolerated clinically and be responsible for a reduction in maternal cardiac output and a reduction in placental perfusion rate causing fetal acidosis. In this context, prophylactic vasopressor treatment is systematically recommended by learned societies. In Africa, particularly in Gabon, this prophylaxis is mainly done with ephedrine. This indirect-acting sympathomimetic, whose easy use is limited by tachyphylaxis, but also by a greater risk of acidosis of the newborn [1,2]. In France, phenylephrine is the recommended vasopressor. However, given these side effects, in particular the increase in cardiac afterload, the reduction in cardiac and uteroplacental output secondary to the increase in vascular resistance, have led to the use of norepinephrine which is a molecule that is both an α-agonist and moderate β-agonist. The objective of this work was to describe the benefit of using babynoradrenaline in the prevention of arterial hypotension in the context of cesarean section under spinal anesthesia.

PATIENTS AND METHODS

After receiving approval from the institutional research ethics committee of the Owendo University Hospital Center, we conducted a prospective, descriptive and observational study

carried out over a period from October 15, 2023 to November 15, 2023. Parturients benefiting of a planned or relative emergency cesarean section under spinal anesthesia during this period were included. The exclusion criteria were refusal of the parturient, cesarean sections performed under general anesthesia, arterial hypertension, cardiovascular or cerebrovascular pathologies, fetal anomalies (acute fetal distress and intrauterine growth retardation).

Description of the anesthesia protocol in preanesthetic consultation, all parturients received clear, fair and appropriate information on the subject of the study.

The babynorepinephrine solution was prepared at a dilution of 100µg.ml-1 by bringing 1 ampoule of 8mg (2ml) of norepinephrine into 6 ml of isotonic saline. Then we take out 5ml of the saline into the 500ml vial, and then 5mg (5ml) of norepinephrine from the stock solution is injected into this saline vial. In the operating room, continuous standard monitoring including an electrocardiogram, non-invasive blood pressure (NIBP) and pulsed oxygen saturation (SpO2) were measured every minute. The measurement of the reference hemodynamic parameters was done in the supine position with a left roll of 10°. Two peripheral venous lines of at least 20 G were placed, one dedicated to intraoperative medication, the other dedicated exclusively to the intravenous infusion of the study molecule. Spinal anesthesia was performed in a seated position after skin disinfection, at L3-L4 or L4-L5 with a 27G pencil needle. A mixture of anesthetic combining Bupivacaine 10 mg and sufentanil 2.5 µg was injected. At the same time, we began the intravenous infusion of the study molecule. The infusion rate was adapted to the SBP measured every minute. The initial flow rate was calculated according to the weight at the end of pregnancy (0.1 µg/kg/h of Noradrenaline).The sensory level was checked by the ice cube test at 5 min, and considered sufficient if greater than or equal to T6. Surgery began as soon as the sensory level was deemed satisfactory by the anesthetic team. Furthermore, oxygen therapy was started if SpO2<95% and antiemetic prophylaxis was not systematic. The study was stopped when weaning the vasopressor.

The other parameters studied were:

- Sociodemographic (age, level of education, profession)

- The indication for cesarean section

- Anesthesiological data (ASA class, time for installation of spinal anesthesia

- Hemodynamic and respiratory parameters (SpO2)

- The state of the newborn by the Apgar score for

- Side effects linked to norepinephrine (episode of dizziness or feeling unwell)

- Side effects of spinal anesthesia (nausea and vomiting)

Statistical analysis was carried out using Microsoft Excel 2016 software. Categorical variables were expressed as percentages and quantitative variables as mean and standard deviation. One-sample t test was used for normally distributed data. The one-sample Wilcoxon signed-rank test was used when data were not normally distributed.

RESULTS

The population of this work consisted of 28 women. Their average age was 30.1 ± 5.6 years with extremes of 20 and 45 years. Parturients aged 25 and 30 represented 43% of the population, followed by those aged 20 to 25 21.4%. The main indications for cesarean sections were scarred uterus with 32% and narrowed pelvis 25%. Caesarean section was performed as planned in 17 patients (60.7%) and as a relative emergency in 11 patients (39.3%). Parturients were classified according to the American Society of Anesthesia (ASA) into ASA1 in 82.1% of cases and ASA2 in 17.9% of cases. The average time for installation of the sensory-motor blocks was 5.86 ± 4.13 min, with extremes ranging from 3 to 20 minutes.

The hemodynamic data at the installation of the block showed a systolic blood pressure (SBP) of between 120 and 140 mmHg in 11 parturients (39.3%) and between 90 and 100 mmHg in 8 women (28.6%). Heart rate (HR) was between 70 and 80 mmHg in 15 patients (53.6%).

The hemodynamic variations observed after the start of the babynorepinephrine infusion showed at the 1st minute a systolic SBP between 100 and 140 mmHg in 20 patients (71.4%) and a SBP less than 100 mmHg in 5 parturients (17.9 %). A heart rate between 60-100 mg in 24 parturients (86%) and greater than 100 in 4 women (14%) [Table 2].

Between the 1st and 5th minutes, a SBP < 100 mmHg was recorded in 3 parturients (10.7%) and greater than 140 mmHg in 3 parturients (10.7%). The heart rate was greater than 100 beats/min in 2 parturients (7.1%) and less than 60 beats/minute in 2 women (7.1%).

Between the 5th and 15th minute, the hemodynamic variations showed a SBP < 100 mmHg in 1 patient (3.6%) and HR < 60 beats/min in 1 patient (3.6%).

Between the 15th and 30th minutes 1 patient (3.6) had a SBP>140 mmHg and no patient had a SBP<100 mmHg. The heart rate was between 60 and 100 beats/minute in all patients. These hemodynamic variations were observed until the baby noradrenaline was stopped.

The extra uterine adaptation parameters of the newborn found an APGAR score between 8 and 10/10 in 25 births (88%) and less than 7/10 in 3 newborns (22%).

The doses of norepinephrine administered to maintain a stable hemodynamic state varied from 0.028 to 0.057µg/kg/min, which corresponded to an average flow rate of 4 drops/min (Figure 1). Adverse effects such as nausea and vomiting were not observed. Arterial hypertension was found in 7 patients (25%), tachycardia in 3 patients (10.7%) and bradycardia in 2 patients (7.1%) [Table 1].

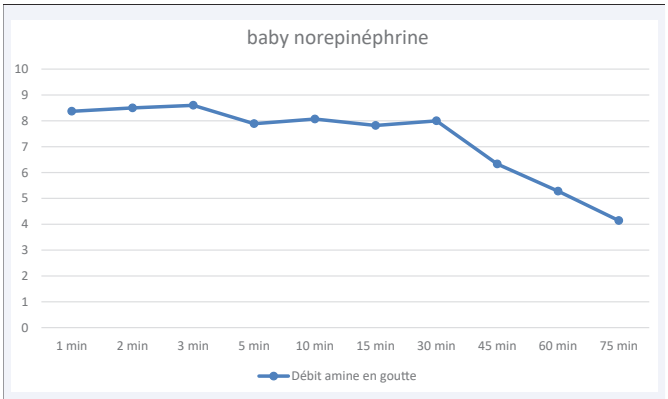

Figure 1 Bar graph of age and sex of rate of cancellation at Debre Markos Comprehensive Specialized Hospital, Debre Markos, Ethiopia, 2022GC. General surgery had the highest number, 100 (49.0%) of cancelled cases, however, ENT surgery had the lowest 2 (1.0%) cancellation rate in DMCSH (Table 2).

Table 1: Systolic blood pressure variations

Systolic blood pressure (SBP)	workforce (n)	Percentage (%)
A la 1ère minute		
PAS < 100 mmHg	5	17,8
100≤ PAS≤140 mmHg	20	71,4
PAS>140 mmHg	3	10,8
Entre la 1ère et 5ème minute		
PAS < 100 mmHg	3	10,7
100≤ PAS≤140 mmHg	22	78,6
PAS>100 mmHg	3	10,7
Entre la 5ème et la 15ème minute		
PAS < 100 mmHg	1	3,6
100≤ PAS≤140 mmHg	24	85,7
PAS>140 mmHg	3	10,7
Entre la 15ème et la 30 ème minute		
PAS < 100 mmHg	0	0,0
100≤ PAS≤140 mmHg	27	96,4
PAS>100 mmHg	1	3,6

Table 2: Variations in heart rate under baby norepinephrine

Cardiac frequency (FC) (batts/min)	workforce (n)	Percentage (%)
A la 1ère minute		
FC < 60	0	0,0
60 ≤ FC≤ 100	24	85,7
FC>100	4	14,3
Entre la 1ère et 5ème minute		
FC < 60	2	7,15
60 ≤ FC≤ 100	24	85,7
FC>100	2	7,15
Entre la 5ème et la 15 ème minute		
FC < 60	1	3,6
60 ≤ FC≤ 100	26	92,8
FC>100	1	3,6
Entre la 15ème et la 30 ème minute		
FC < 60	2	7,15
60 ≤ FC≤ 100	26	92,85
FC>100	0	0,0

DISCUSSION

Spinal anesthesia is the technique of choice for cesarean delivery. The main problem with this technique is arterial hypotension which is associated with a reduction in cardiac output and uteroplacental flow. This hypotension can induce maternal and fetal morbidity. The prevention of this hypotension is a concern for the anesthesiologist-resuscitator. The main therapies are vascular filling with crystalloids and the use of catecholamines. During the period of this study, 28 patients were included. It was essentially a young population with an average age of 30.1±5.4 years and extremes of 21 and 45 years. Patients whose age varied between 20 and 30 years represented 64.4% of the population. This average age reflects the reality of populations in Africa [3]. The study population was mainly ASA1 (82.1%). Young age may account for the low frequency of comorbidities found. Caesarean sections were planned in 60.7% of cases, with the main indications being scarred uterus (32%) and narrowed pelvis (25%). These are common indications [4, 5].

Spinal anesthesia is responsible for sympatholysis, which will lead to a reduction in cardiac output and blood pressure. This mechanism is understood by an increase in venodilation, which will cause a reduction in venous return, and therefore in blood pressure. The use of norepinephrine, whose predominant effects are venoconstriction, will be responsible for an increase in cardiac preload, cardiac output and BP. This explains the maintenance of the BP obtained in this work. Indeed, 78.6% of patients (n=15) had a stable SBP (100-140 mmHg) during the first five minutes after spinal anesthesia. Between the fifteenth and thirtieth minutes, 96.4% had a SBP in the same interval. Over the 75 minutes of norepinephrine administration, the average SBP value was above 110 mmHg. The literature confirms the good impact of noradrenaline on hemodynamics during cesarean sections under spinal anesthesia [6,7].

Also, norepinephrine also has a weaker beta effect and also a mild chronotropic effect at low doses (Babynorepinephrine). Hence the stability of the heart rate observed in this work. This stability of heart rate with the administration of norepinephrine is comparable to that found with phenylephrine [8]. In this series, a heart rate between 60 and 100 beats/min was recorded in 85.7% of patients at the first minute and between the first and 5th minute and in 92.85% (n=26) between the 15th and 30th minute. The method of administration of norepinephrine in this work was by slow infusion in drops/minutes. The administration was started from the first minute, after the spinal anesthesia was performed. Overall, the norepinephrine flow rate varied between 4 to 10 drops per minute.

This would correspond to doses of 0.028 to 0.057 µg/kg/min. our practice is not in agreement with the literature recommending constant flow rate administration [9]. The choice of the mode of administration could be explained by the lack of electric self-pushing syringe, and flow regulator devices (flow meters) in our department during the study period on the one hand and on the other hand by the desire to popularize the use

of babynoradrenaline in all health structures in the country where cesareans are performed. This mode of administration could explain the adverse effects encountered in this work. Indeed, either a larger dose was administered explaining the hypertension found in seven patients (25%), or on the contrary persistent hypotension (n=10) due to a lower flow rate below 0.025µg/kg/min. This low flow rate may also be related to the occurrence of bradycardia found in 2 patients. Data on adaptation to extrauterine life are assessed by the Apgar score. In this work, hemodynamic stability made it possible to maintain good placental perfusion. Newborns mostly had an Apgar greater than or equal to 8 at the first minute. Norepinephrine in the baby form does not pass the uteroplacental barrier and does not cause fetal stress, often responsible for fetal tachycardias and acidosis, which can compromise the fetal prognosis [9]. This also explains the good APGAR scores found in the majority of newborns.

CONCLUSION

Spinal anesthesia during cesarean sections is responsible for sympatholysis, which causes arterial hypotension. Management of this involves the use of vasopressors and norepinephrine in the form of babynorepinephrine is a good alternative today. In both the mother and the fetus, there is better hemodynamic stability and fewer adverse effects. It ensures good hemodynamic stability of the mother and therefore good uteroplacental perfusion.

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