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ORIGINAL ARTICLE

The evaluation of brain natriuretic peptide changes and difficult airway predictors during perioperative period of pregnancy

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Abstract
Aim Airway changes, difficult ventilation, and intubation are the leading causes of morbidity and mortality in pregnancy, but no prospective study has evaluated the relationship between airway changes and brain natriuretic peptide (BNP) before and after cesarean section operations. The purpose of this study was to evaluate the relationship between BNP and airway changes in women undergoing delivery and during the postoperative period.
Materials and methods Included in this prospective study were a total of 35 pregnant females with ASA I physical status who were scheduled for cesarean section under general anesthesia. BNP levels, Mallampati classification, mouth opening, thyromental distance, sternomental distance, and the degree of neck extension were recorded before cesarean section and 24 h after the operation. Laryngeal views were also documented after intubation.
Results Significant differences in BNP levels, Mallampati classification, mouth opening, thyromental distance, sternomental distance, and the degree of neck extension measurements arose between initial measurements and those measurements made 24 h postoperatively. Predelivery Mallampati I, II, III, IV scores of 6, 18, 7, 4 had by 24 h after cesarean section changed to 13, 13, 6, 3, respectively ($p < 0.05$). Initial BNP levels were 7.59 ± 6.30; postoperative levels were 52.39 ± 48.17. In this study we found a correlation between perioperative BNP levels and difficult intubation parameters.
Conclusions Within 24 h postpartum, Mallampati scores changed in 13 patients (30.95 %). Besides the correlation between BNP levels and difficult intubation parameters, we also found significant differences in initial and postoperative BNP values.

Keywords BNP · Airway · Pregnancy · Difficult · Intubation

Introduction

In pregnancy, women experience diverse physiologic changes such as increased weight gain, airway edema, and increased volume of the breasts, besides effects from intubation during anesthesia. Due to increased plasma volume and total body water, compartment airway edema is one of the most influential factors in difficult intubation

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in parturients [1, 2]. Difficult intubation prediction tests are available, but are not 100 % reliable.

The B-type natriuretic peptide (BNP) is a neurohormone secreted by the cardiac ventricles in response to volume or pressure overload. Because BNP is excreted from cardiac ventricles in response to volume expansion, BNP is employed routinely in diagnosis and follow-up of cardiovascular diseases.

Previous studies that investigated BNP levels during term pregnancy and pre-eclampsia [3, 4] found median BNP levels of <20 pg/ml during pregnancy. In term pregnancy, BNP levels show continuous rise and then a dramatic decline to normal levels in the early postpartum phase [3]. We planned this study to investigate if the improvement in difficult intubation predictors after cesarean section (C/S) correlates with BNP levels.

Materials and methods

Included in this study were 35 term parturients having ASA scores of I who were to undergo C/S operations. The Ethics Committee of the Bezmialem Vakif University approved this study, which took place between January 2012 and July 2013. All patients gave their written informed consent for participation. Patients who had chronic heart disease, pre-eclampsia, eclampsia, chronic hypertension, diabetes mellitus, or systemic lupus erythematosus and complicated pregnancies were excluded from this study. For BNP measurements, blood samples were obtained from each patient just before and 24 h after her operation. The same senior anesthetist recorded patient weight, Mallampati classification, sternomental distance, thyromental distance, mouth opening, and atlanto-occipital angle measurements. Thyromental distance is defined as the distance from the thyroid notch to the mental protuberance; sternomental distance is defined as the distance between the sternal notch and the mental protuberance. The interincisor gap was measured when the patient had her mouth open. Angles were measured with a bubble goniometer to obtain the degree of head extension. While the patient was in a supine, resting position, the angle was measured between a line joining the angle of her mouth and the tragus of her ear. The four-point Mallampati scale was employed to assess the oropharyngeal view. Intravenous fluid therapy was standardized. All patients received 2,000 ml crystalloid infusion during the operative period, and 3,000 ml crystalloid infusion in the first 24 h after the operation. Patients were free to take oral fluids after the operation. Laryngeal views of the glottis were evaluated according to Cormack-Lahane.

The sample size of this study was determined from a previous study, that of Hameed et al. [5], the study which guided our study. A minimum of 25 patients was assumed as a preliminary sample size. The 35-patient maximum sample size was based on the post hoc power calculation of ΔBNP (44.79 ± 45.38) levels, which showed 0.99 of the power of our study.

The Wilcoxon sign rank test was used to assess ΔBNP, and the Pearson correlation test was used to assess the differences among difficult intubation criteria in the first 24 h after the C/S operation. The Wilcoxon Test was used for the matched groups which were not normally distributed, and the Spearman Rho test was employed for analyzing the correlations between BMI, BNP levels, and difficult intubation criteria.

Table 1 Demographic variables, fluid intake and fasting times

	Mean ± SD
Age (years)	29.94 ± 4.95
Height (cm)	160.6 ± 5.61
Weight (kg, before birth)	74.48 ± 10.24
Weight (kg, after birth)	71.39 ± 9.86
Oral fluid intake after C/S (ml)	2,497 ± 1,202
Fasting times (min)	583 ± 99.5
Total fluid input from time of airway assessment: intravenous crystalloid infusion (ml)	5,000

Table 2 Perioperative difficult intubation criteria and BNP levels

	Before birth	After birth[a]	p
Thyromental distance (cm)	8.73 ± 1.73	9.71 ± 1.32	<0.05
Sternomental distance (cm)	13.56 ± 2.78	14.74 ± 2.23	<0.05
Mouth opening (cm)	5.64 ± 0.52	6.07 ± 0.47	<0.05
The degree of neck extension	84.31 ± 16.57	87.68 ± 18.16	<0.05
Mallampati I, II, III, IV (*n*=)	(6, 18, 7, 4)	(13, 13, 6, 3)	<0.05
Laryngeal view (1–2–3–4) (*n*=)	(3, 29, 3, 0)		
BNP	7.59 ± 6.30	52.39 ± 48.17	<0.05

Values are expressed as mean ± SD or number of patients

[a] 24 h after cesarean section

Results

Demographic data and preoperative and postoperative weight measurements of the patients are shown in Table 1. Δ sternomental distance and Δ thyromental distance were found to be statistically significant ($p < 0.001$; Ro: 077). $p < 0.05$ was accepted as statistically significant.

In total, 70 preoperative and postoperative BNP measurements were recorded and analyzed. After routine preoperative fasting in term pregnant patients, BNP levels increased almost sevenfold by the end of 24 h after the elective C/S operations, with a significant difference between preoperative and postoperative readings 24 h after the C/S operation. BNP levels, Mallampati classification, mouth opening, thyromental distance, sternomental distance, and the degree of neck extension were recorded and analyzed. All differed to a statistically significant degree ($p < 0.05$, Table 2). Significant positive correlations were found between BNP levels and Mallampati classification, mouth opening, sternomental distance, the degree of neck extension, and thyromental distance.

Total sum of intravenous crystalloid infusion was 5,000 ml in the perioperative 24 h. The amount of blood loss during C/S was approximately 800–1,000 ml. Oral fluid intake after C/S was 2,497 ± 1,202 ml.

Discussion

A previous study from our unit on 61 pregnant women who underwent normal vaginal birth had showed significant improvement in difficult intubation prediction tests after delivery [6]. That study confirms the findings of this current research that BNP levels correlate with difficult intubation parameters. Due to its natriuretic, diuretic, and vasorelaxant features, an elevation of BNP can be expected at the postoperative period [7]. The postoperative increase in BNP levels may also be due to the removal of the placenta, which leads to decreased progesterone levels. Resolution of pregnancy edema improves the results of difficult intubation prediction tests in the postoperative period.

Reduction in colloid osmotic pressure during pregnancy has been demonstrated in several previous studies. In addition, estrogen reduces capillary albumin leakage from endothelium resulting in a 21 % increase in plasma volume and sodium retention, which increases maternal blood volume that leads to colloid osmotic pressure reduction and an increase in hydrostatic pressure that could be a cause of airway edema [8–10].

Airway changes have been observed during the preoperative and postoperative periods, as well as an increased number of the Mallampati Class I–II patients (Table 2). Pilkington et al. [11] attributed these changes to the fluid retention of pregnancy. Nowadays, the number of C/S operations is increasing. Regional anesthesia is the first choice in C/S operations; however, in selected cases or in emergency situations, general anesthesia is considered an option. For this reason, difficult intubation is still a major problem during a C/S operation.

Airway management could be a major problem in general anesthesia cases and in patients who require general anesthesia after a failed or impossible regional anesthetic approach. A recent study showed that the incidence of an unanticipated difficult intubation in pregnant patients is 0.56 % [12], and is usually multifactorial due to physiological and anatomical conditions secondary to pregnancy.

Previous studies showed an inverse correlation with obesity and BNP values, and that obese patients have difficulties increasing BNP levels to the same extent after saline infusion. BNP levels were decreased after weight loss due to diet or adjustable gastric band operations; however, BNP levels were increased after gastric bypass surgery and correlated with weight reduction [13–19].

According to our study, BNP levels rapidly alter immediately after the C/S operation. At the end of 24 h, all difficult intubation criteria improved and we found each factor significantly correlated with BNP.

Our study is the first study to show variations between difficult intubation criteria and BNP levels after C/S operations under general anesthesia. Fluid volume overload is one of the major reasons for an increased incidence of difficult intubation in pregnant patients. Our study confirmed that the resolution of this volume overload and increase in BNP levels showed subsequent improvement in airway views. In conclusion, our study showed a significant improvement in difficult intubation criteria and a subsequent increase in BNP levels in the first 24 h after a C/S operation.

Conflict of interest None.

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