



Prediction of intraoperative nausea and vomiting in caesarean delivery under regional anaesthesia

Altuğ Semiz¹, Yaşam Kemal Akpak²,
Necip Cihangir Yılanlıoğlu¹, Ali Babacan³,
Gökhan Gönen⁴, Canan Çam Gönen⁵,
Murat Asliskender⁶ and Selim Karaküçük⁵

Abstract

Objectives: This study aimed to predict patients who have caesarean operations under regional anaesthesia and are at risk for intraoperative nausea and vomiting (IONV), for ultimately prompting anaesthetists and surgeons to take preventive measures.

Methods: This was a retrospective study on 209 patients who had caesarean section under spinal-epidural combined regional anaesthesia. The relevant medical history, such as severe nausea and vomiting in the first trimester, smoking, a history of motion sickness, and premenstrual syndrome (PMS), were obtained from the patients' records and interviews.

Results: Patients who had a female neonate, a history of severe nausea and vomiting in the first trimester, and a history of PMS and motion sickness before pregnancy experienced a significantly higher rate of IONV. Smokers were less susceptible to IONV, but this was not significant.

Conclusion: This study shows that some factors in the medical history of a patient can help identify those who are more likely to suffer from IONV.

Keywords

Caesarean delivery, regional anaesthesia, obstetric surgery, intraoperative nausea and vomiting, prophylactic medication

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¹Memorial Hospital, Fetal Medicine and Perinatology Unit, Istanbul, Turkey

²Ankara Mevki Military Hospital, Department of Obstetrics and Gynecology, Ankara, Turkey

³GATA Haydarpaşa Training Hospital, Department of Obstetrics and Gynecology, Istanbul, Turkey

⁴Necip Fazıl State Hospital, Department of Obstetrics and Gynecology, Kahramanmaraş, Turkey

⁵Necip Fazıl State Hospital, Department of Anesthesiology, Kahramanmaraş, Turkey

⁶GATA Haydarpaşa Training Hospital, Department of Anesthesiology, Istanbul, Turkey

Corresponding author:

Yaşam Kemal Akpak, Department of Obstetrics and Gynecology, Ankara Mevki Military Hospital, Ankara 06100, Turkey.

Email: yasamaster@gmail.com



Introduction

As major problems of anaesthesia have been overcome in modern medicine, research has focussed on some other relatively minor difficulties. Most such minor problems remain unpredictable. Therefore, this field of research is important because some of these problems may progress from a state of inconvenience to a situation of disturbing morbidity.^{1,2} Nausea and vomiting in the postoperative period of epidural anaesthesia is a well-studied subject, but intraoperative nausea and vomiting (IONV) has not been well studied.^{3,4} Nausea and vomiting with onset during the operation and persisting in the postoperative period cause reduced patient comfort, delayed discharge from the hospital, and an increase in costs. This problem deserves more attention when some possible consequences, such as dehydration, electrolyte imbalance, wound dehiscence, venous hypertension and bleeding, rupture of the oesophagus, airway obstruction, and aspiration pneumonia, are taken into account.^{5,6}

Nausea and vomiting are not uncommon in a wide variety of surgical operations. However, this problem arises even more often in caesarean operations under regional anaesthesia.⁷ Increased intra-gastric pressure, hypotension, stretching the peritoneum (exteriorization of the uterus), excessive surgical manipulation and visceral stimulation, using opioids, using uterotonic agents, and the patient's mental status play a role and place the patient at high risk for IONV.^{4,7-9} Hypotension associated with spinal,⁶ epidural,^{10,11} and spinal-epidural (combined) anaesthesia¹² is a particularly important contributing factor for IONV. Some details associated with the surgical technique, such as peritonealization, exteriorizing the uterus for suturing, and peritoneal washing, may also contribute to IONV.⁸ The incidence of IONV is as high

as 80%.⁷ Therefore, prophylactic medication for this condition is critical.

Previous studies that have been conducted on IONV have focussed on treatment, rather than prevention, of this condition. Preoperative and intraoperative administration of midazolam and propofol, close monitoring of hypotension, achieving a good anaesthetic block, a gentle surgical technique, and judicious use of uterotonic agents appear to have beneficial effects on IONV.⁶⁻⁸

This study aimed to investigate the effect of particular anaesthetic and surgical techniques and the significance of the antenatal-medical-surgical history on occurrence of IONV in patients who have caesarean delivery under regional anaesthesia. Our results could prompt anaesthetists and surgeons to take appropriate preventive measures.

Methods

The study was retrospectively conducted by the Memorial Hospital (private hospital), GATA Haydarpaşa Training Hospital (academic military hospital), and Necip Fazıl State Hospital (training status, state hospital) between March 2014 and February 2015. A total of 209 women were selected to participate in this multicentre study. The sample size was considered sufficient to draw conclusions because the condition of IONV is as common as 50–80% in caesarean sections under epidural anaesthesia. The study protocol was approved by the ethics committee of GATA Haydarpaşa Training Hospital. The inclusion criteria were as follows: regular antenatal clinic attendance (at least one attendance in the first trimester and observation four times weekly, or complying with the attending obstetrician's advice, more often until term); elective caesarean section (the patient's decision was not to have vaginal delivery); singleton pregnancy; and cephalic presentation. The

exclusion criteria were as follows: any history of diabetes, hypertension, thyroid disease, obesity, gastrointestinal disease, anaemia or any other condition requiring long-term medication; no history of alcohol or drug abuse; and no major complications of pregnancy (pregnancy-induced hypertension, preeclampsia, gestational diabetes) in the antenatal period. Only patients with the above-mentioned details recorded in their hospital records and who could provide information to complete the data set when contacted were included in the study. Epidural anaesthesia was applied under the following routine: 1000 ml of Isolyte-S solution was infused as a co-load through a 20 gauge peripheral intravenous catheter. An electrocardiogram, blood pressure, heart rate, and peripheral oxygen saturation were continuously monitored. The patient was placed in the seated position and 2% lidocaine infiltration was performed at the appropriate level. A combined spinal-epidural Tuohy needle (Tuohy Portex 19 G) was progressed to the epidural space using the technique of loss of resistance with normal saline. The spinal needle was further advanced through and free flow of cerebrospinal fluid was observed. A combination solution of 2 ml 0.5% bupivacaine hydrochloride anhydrous (Marcain Heavy) and 25 mcg fentanyl was injected. The spinal needle was withdrawn and the catheter remained *in situ* for continuous epidural anaesthesia with 0.5% bupivacaine. The epidural catheter was then progressed for 4 to 5 cm cranially. The needle was withdrawn and the catheter was fixated. The level of sensory block was tested by temperature sensation.

A common operative technique adopted by obstetricians was performed as follows. A Pfannenstiel incision was performed using scissors to open the fascial and peritoneal layers (to minimize the peritoneal stretch factor), and a scalpel incision was made for a

lower segment transverse (Kerr) uterotomy, which was extended sideways by the fingers. The foetus was delivered by directing the occiput to the incision and moderate fundal pressure by the assistant. The uterus was not exteriorized during repair. If the uterus had to be exteriorized for any reason, the patient was excluded from the sample. The average operating time was 30 minutes (range, 24–50 minutes) from making the incision to completion of skin closure. As soon as the newborn was delivered, 1 ml of oxytocin (Synpitan, 5000 mIU) was added to 500 ml of isotonic sodium chloride (0.9% NaCl) infusion in addition to a bolus of the same dose. The patients were monitored to determine whether they felt nauseated during caesarean delivery and nausea was recorded along with vomiting episodes if encountered. Treatment was provided as appropriate by the anaesthetist when vomiting occurred. Epidural anaesthesia was performed using the same technique by the anaesthetists in each of the three assigned hospitals with similar times for the procedure.

Using records or interviews, severe nausea and vomiting in the first trimester (1st TM nausea/vomiting) was accepted as present when the patient expressed this complaint in the antenatal clinic in the first trimester, as occurring every day and requiring antiemetics other than herbal or dietary measures. A distinction between emesis and hyperemesis was not made. Smoking was recorded as positive if the patient continued or started smoking while pregnant. Motion sickness was recorded as positive when the patient described nausea and/or vomiting during a car, boat, or air travel before pregnancy as shown on records or interviews. PMS was recorded as positive using the patients' description and answers based on the criteria of the International Society for Premenstrual disorders.

Statistical analysis was conducted using PASW 18.0 for Windows. To form the

sample group, we chose criterion sampling of the purposive/purposeful sampling approach where only those patients who conformed to some specified criteria were included. The descriptive statistics for categorical variables are shown as counts and percentages. Continuous variables are shown as mean, standard deviation, median, 25th percentile, 75th percentile, minimum, and maximum. For continuous variables, the Mann–Whitney U test was used for testing differences between groups when the assumption of normality was not satisfied. For categorical variables, the chi-square test was used when its conditions were met. Otherwise, Fisher's exact test was used. Furthermore, logistic regression was used to determine the risk factors, where the level of significance was $p < 0.05$.

Results

A total of 209 women with a mean age of 29.88 ± 5.12 years were included in this multicentre study. Mean body mass index was 28.37 ± 4.40 . The number of patients with 1st TM nausea/vomiting was 59 (28.2%), the number of smokers was 20 (9.6%), and the number of those describing motion sickness was 47 (22.5%). The number of patients who experienced PMS before pregnancy was 20 (9.6%). A total of 111 of the newborns were female (53.1%) and 98 were male (46.9%). All of the parameters are shown in Table 1.

Of the 209 patients included in the study, 77 (36.8%) patients experienced nausea during the caesarean operation and 19 (9.1%) suffered from vomiting. Patients who experienced nausea intraoperatively had a significantly higher rate of 1st TM nausea/vomiting, motion sickness, and a female newborn than did those who did not experience nausea intraoperatively ($p < 0.001$, $p < 0.001$, $p = 0.009$, respectively) (Table 2). Patients who had a female newborn, 1st TM nausea/vomiting, and a

Table 1. Summary of parameters.

N = 209		
Age, mean \pm SD (median)		29.88 \pm 5.12 (30.00)
BMI, mean \pm SD (median)		28.37 \pm 4.40 (28.20)
1st TM nausea/vomiting, n (%)		59 (28.2)
Smoking, n (%)		20 (9.6)
Motion sickness, n (%)		47 (22.5)
PMS, n (%)		20 (9.6)
Newborn sex, n (%)	Male	98 (46.9)
	Female	111 (53.1)

BMI: body mass index; 1st TM nausea/vomiting: severe nausea and vomiting in the first trimester; PMS: premenstrual syndrome; SD: standard deviation.

history of PMS and motion sickness before pregnancy experienced a significantly higher rate of IONV ($p < 0.001$, $p = 0.017$, $p = 0.023$, $p = 0.004$, respectively) (Table 3).

In the model that was formed by inclusion of variables that showed significance for nausea (age and comparison analyses, $p < 0.250$), a history of 1st TM nausea/vomiting and motion sickness, but not PMS, were significant risk factors ($p < 0.001$, $p < 0.001$, respectively) (Table 4). In the model that was created for evaluation of risk factors for vomiting, the parameters that were significant by multivariate analyses (age and comparison analyses, $p < 0.250$) were 1st TM nausea/vomiting and a female foetus ($p < 0.001$, $p = 0.045$, respectively) (Table 5).

Discussion

In this study, we primarily aimed to define preventive measures for intraoperative nausea and vomiting during caesarean section under epidural anaesthesia. After maintaining the parameters of surgical, medical, and anaesthesiological factors within certain standards, a female newborn, nausea and vomiting in the first trimester, and a history of PMS and motion sickness were risk factors for IONV. We conclude that this group of patients will benefit from prophylactic medication.

Table 2. Characteristics of patients who experienced nausea during the operation.

	Nausea (-) N = 132	Nausea (+) N = 77	p
Age, median (25th–75th percentile)	30.00 (26.00–34.00)	30.00 (26.00–34.00)	0.749
BMI, median, (25th–75th percentile)	28.10 (25.50–30.50)	28.20 (26.20–29.80)	0.870
1st TM nausea/vomiting, n (%)	17 (12.9)	42 (54.5)	<0.001
Smoking, n (%)	9 (6.8)	11 (14.3)	0.077
Motion sickness, n (%)	9 (6.8)	38 (49.4)	<0.001
PMS, n (%)	10 (7.6)	10 (13.0)	0.200
Newborn sex, n (%)			0.009
	Male	27 (35.1)	
	Female	50 (64.9)	

BMI: body mass index; 1st TM nausea/vomiting: severe nausea and vomiting in the first trimester; PMS: premenstrual syndrome.

Table 3. Characteristics of patients who experienced vomiting during the operation.

	Vomiting (-) N = 190	Vomiting (+) N = 19	p
Age, median (25th–75th percentile)	30.00 (26.00–34.00)	29.00 (24.00–31.00)	0.144
BMI, median (25th–75th percentile)	28.20 (25.70–30.00)	28.40 (27.30–30.40)	0.464
1st TM nausea/vomiting, n (%)	45 (23.7)	14 (73.7)	<0.001
Smoking, n (%)	19 (10.0)	1 (5.3)	1.000
Motion sickness, n (%)	38 (20.0)	9 (47.4)	0.017
PMS, n (%)	15 (7.9)	5 (26.3)	0.023
Newborn sex, n (%)			0.004
	Male	3 (15.8)	
	Female	16 (84.2)	

BMI: body mass index; 1st TM nausea/vomiting: severe nausea and vomiting in the first trimester; PMS: premenstrual syndrome.

Regional anaesthesia is a safe method for elective and emergency caesarean sections.^{8,14} IONV has been reported to be as high as 50% to 80% in caesarean sections, while in non-obstetric operations, this rate ranges from 7% to 42%.^{7,8} This condition is affected by factors that are particular to the patient, anaesthesia, and surgery. Prediction of IONV is important for enabling appropriate and timely use of antiemetics.^{15,16} Apfel et al.¹ described a useful risk scoring system based on four parameters for post-operative nausea and vomiting (PONV), but there is no such system for IONV. Therefore, there is no such system in caesarean section under spinal anaesthesia.

In most studies on IONV, only the triad of patients, surgery, and anaesthesia were kept constant and other parameters were investigated. Predictive factors concerning the patient have been more consistently defined, but those concerning surgery and anaesthesia have been more variable and uncontrolled.

Our study showed that nausea was more likely to occur if the patient's history consisted of 1st TM nausea/vomiting, when a history of motion sickness before pregnancy was present, and if the newborn was female. This is an interesting finding because it has not been shown in other studies. Female sex of the newborn has been shown to be closely

Table 4. Risk factors for nausea.

	p	OR	95% CI for OR	
1st TM nausea/vomiting	<0.001	6.75	3.03	15.05
Motion sickness	<0.001	12.02	4.62	31.30
Absence of PMS	0.068	3.41	0.91	12.75

1st TM nausea/vomiting: severe nausea and vomiting in the first trimester; PMS: premenstrual syndrome; CI: confidence interval; OR: odds ratio.

Table 5. Risk factors for vomiting.

	p	OR	95% CI for OR	
1st TM nausea/vomiting	<0.001	7.36	2.47	21.96
Foetal sex (female)	0.045	3.80	1.03	14.01

1st TM nausea/vomiting: severe nausea and vomiting in the first trimester; CI: confidence interval; OR: odds ratio.

associated with hyperemesis gravidarum in previous studies.^{17,18} This situation might be due to high oestrogen levels. The fact that IONV is observed less frequently with advanced maternal age, which is attributed to decreased oestrogen levels, also supports this hypothesis.¹ In non-obstetric operations, women are four times more susceptible to nausea and vomiting than men.^{1,2} This rate decreases after menopause, but still remains higher than that in men, which supports a significant role of sex hormones in nausea and vomiting.^{19,20}

Previous studies have shown that being a non-smoker results in more susceptibility to IONV, but this finding was not confirmed in our study.^{1,2,21} The only finding in our study that was related to this previous finding, which suggests that liver enzymes are induced by smoking and thus produce a protective effect on IONV, was the higher number of smokers in the group without vomiting. However, this finding did not reach significance. We also found that 1st TM nausea/vomiting in addition to motion sickness were also significant risk factors for

IONV. Migraines are also a contributing factor in PONV.^{2,22} We found that the rate of PMS was significantly higher in the group affected by vomiting compared to the group who had nausea only. While the mechanism of PMS is not completely known, women with PMS are considered to have increased sensitivity to hormonal changes along with neurotransmitter abnormalities.²³

The presence of gastric distension, an operating time exceeding 30 minutes, use of opioids intraoperatively, nitrous oxide, and positive pressure ventilation with a face mask increase the likelihood of IONV.^{3,24} The stimulating agents of the vomiting mechanism comprise the vagal nerves, cerebral cortex, vestibular body, and the chemoreceptor trigger zone. The receptors of dopamine, serotonin, histamine, and muscarine play a role in this process.^{19,25} All studies on these aspects have been at the epidemiological level. There is a notable lack of studies at the genetic and molecular biology level, which would provide more understanding on the pathology and management of IONV.

Previous studies have suggested that to prevent IONV during caesarean section, blood pressure must be closely monitored, use of opioids must be kept to a minimum, the operative technique must be gentle with minimum displacement of the uterus (not exteriorising through an incision), and uterotonics and antibiotics must be administered in dilute and slow infusions. Our study shows that if a patient has a history of PMS, motion sickness, or severe nausea-vomiting in the first trimester, and the newborn is a girl, prophylactic antiemetics should be used. Further work on this issue is necessary to confirm the role of the factors that we analysed in this study in identifying candidates who are at risk of IONV and the effectiveness of measures in its prevention. A scoring system could be devised in such a study to enable clinicians to identify patients at risk for IONV more specifically and effectively.

Limitations of the study

In this study, we examined some potential factors, including the medical history, medication in the operating room, and anaesthetic and surgical techniques that may play a role in the occurrence of IONV during caesarean section under spinal-epidural anaesthesia. Our study was retrospective, which should ideally be prospective where the parameters could be better controlled. This, alongside the relatively modest sample size may throw shadow on the reliability of the results.

Consent

The study protocol was approved by the ethics committee of GATA Haydarpara Training Hospital.

Declaration of Conflicting Interest

The authors declare that there is no conflict of interest.

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