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Case Report

Anesthesia for Cesarean Delivery in the Morbidly Obese Parturient - Comparison of Commonly used Anesthesia Techniques

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Abstract

Background: Obesity in pregnancy can add significantly to obstetric and anesthetic complications. The objective of this study is to identify and compare anesthesia-related complications in different types of elective cesarean anesthetics in morbidly obese parturients.

Methods: Retrospective review was done on 205 records of elective cesareans for pregnants with Body Mass Index (BMI) ≥ 40. Data extracted include: type of anesthesia, intraoperative and early postoperative complications, duration of surgery, newborn birth weight, cord blood pH and Apgar scores.

Results: The incidence of significant intra-operative hypotension: 65.0%, bradycardia 3.04%, nausea and vomiting 14.21%. Intraoperative hypotension: 67% in spinal and CSE group vs. 34.8% in epidural group (p = 0.0022). Super Morbid Obese (SMO) patients (BMI > 50) had a greater number of attempts at placement for regional techniques compared to Morbidly Obese (MO) patients (BMI 40−49.9) (2.02 vs. 2.61, p = 0.0255). SMO patients had longer mean surgical times (86.6 vs. 107.55 min, p = 0.0001), received more intraoperative crystalloids (1887 vs. 1699 ml, p = 0.0376) and colloids (33.9 vs. 12.6%, p = 0.0007) compared to MO patients. No other complications were significantly different between the 2 compared anesthetic techniques or BMI classes.

Conclusion: Spinal anesthesia was the most commonly used technique. It resulted in more hypotension. Parturients with BMI ≥ 50 were more challenging to manage with more regional

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anesthesia placement attempts, larger fluid volumes and longer surgery times. A well-organized RCT could prove beneficial in validating the most profitable and safe anesthetic technique for bariatric parturients.

Introduction

Obesity is a worldwide growing healthcare problem affecting women of childbearing age. This was clearly identified in the World Health Organization (WHO) consultation report which classified obesity based on Body Mass Index (BMI) and related this to risk of comorbidities (Table 1) [1-4]. In this classification system, a BMI greater than 29.9 was defined as obese. Furthermore, the American National Heart, Lung, and Blood Institute (NHLBI) classified persons with BMI ≥ 40 as extremely or morbidly obese. Many studies have shown the increasing prevalence of obesity among adults to more than double in the past three decades, and that obesity continues to be a public health concern. In fact, in 2007-2008 about one third of the adult population in the United States had BMI of 30.0 or more [5-7].

Class	BMI (Kg.m⁻²)	Risk of Comorbidities
Normal	18.5-24.9	Medium
Overweight	≥ 25	
Pre-obese	25-29.9	Increased
Obese class 1	30-34.9	Moderate
Obese class 2	35-39.9	Severe
Obese class 3	≥ 40	Very severe

Table 1: WHO Classification of Obesity.

The dramatic rise in the rate of obesity recorded in general population also involves women of reproductive age. In the United States, pre-pregnancy obesity was found to increase from 13% in 1993-1994 to 22% in 2002-2003 in a study looking at trends in pre-pregnancy obesity [8].

Obesity is occurring with increasing frequency during pregnancy, such that in the last decade, maternal and fetal risks are being qualified, quantified and documented. It is well known that any bariatric patient is at risk for diseases such as diabetes, hypertension, respiratory diseases (including obstructive sleep apnea), and deep venous thrombosis, in addition to surgical complications such as wound infection [1]. If pregnancy is superimposed on being significantly overweight, patients become more prone to the development of antenatal diseases including pre-eclampsia, gestational diabetes, venous thrombo-embolism, large for gestational age infants, and preterm deliveries [4,9,10].

The objective of this study was to identify the types of anesthesia that were employed for elective cesarean deliveries in morbidly obese parturients (BMI ≥ 40) in our institution. In doing so, we sought to illustrate potential anesthesia-related adverse effects occurring during cesarean delivery for this patient cohort, and to discern whether there is a safer and more proficient anesthetic technique for this unique patient population.

Methods

This study was approved by the Ottawa Hospital Research Ethics Board (OHREB) - protocol #2011157-01H. In this retrospective cohort study, we included pregnant women with BMI ≥ 40 at delivery time, who delivered their infants by planned cesarean section between Jan 1, 2007 and January 31, 2011 at the Ottawa Hospital. The Ottawa Hospital (Civic and General Campuses) is an academic tertiary care centre in Ottawa, Ontario, Canada, with a delivery rate of ~ 7,000 per year. Emergency cesarean deliveries were excluded. In order to identify parturients fitting our inclusion criteria, approval was granted, by the regional coordinator, for information access to Niday perinatal database, which is Ontario's perinatal database website. Once found, the pertinent patient charts were accessed from the Ottawa Hospital Medical Records Department and reviewed, by a single investigator (A.S.F.) to collect the required study data.

Maternal clinical characteristics that were extracted from the charts included: age, body weight, height, delivery BMI, American Society of Anesthesiologists (ASA) physical classification class, co-morbidities and current medications. Data related to the anesthetic technique that was extracted included: type of anesthesia, number of attempts required for successful regional anesthetic techniques, needle types used including the needle length and gauge, use of ultrasound to aid in regional anesthesia placement. In addition, information related to the duration of surgery, estimated blood loss and total amount and types of intra-operative fluids were recorded.

The first outcome measure was the composite intraoperative and early postoperative (in Post-Anesthesia Care Unit-PACU) anesthesia related adverse effects which included: incidence and duration of significant hypotension (defined as Systolic Blood Pressure -SBP < 25% of baseline or ≥ 90 mmHg), along with the treatment required (if any), specifying type and dose of vasopressors and/or intravenous fluids administered. Also, the incidence of maternal bradycardia and type and doses of anticholinergic medications if used, incidence of nausea and vomiting, with the type and doses of antiemetic medications if used.

Other outcome measures included the length of stay in PACU and the frequency of the need for additional intraoperative and early postoperative (in PACU) Intravenous (IV) analgesia, other than our routine acetaminophen and ibuprofen adjuvants. Also, data linked to the fetal outcome were evaluated including: baby's birth weight, Apgar scores at 1 and 5 minutes and fetal umbilical cord arterial blood pH. We compared between the spinal and epidural groups of patients in terms of the incidence of intra- and early post-operative complications. Also, we divided our studied group of patients into according to the delivery BMI, into 2 groups: parturients with BMI 40-49.9 (morbidly obese) and the group of parturients with BMI of 50 or more (super morbidly obese). A comparison was made between these two groups of patients regarding all the collected data.

All categorical variables were compared by x^2 test or Fisher's exact test where appropriate. All continuous variables were compared using the independent t test. SAS 9.2 was applied to conduct the statistical analysis.

Results

Two hundred and five medical records, for patients who have fulfilled our inclusion criteria, were reviewed. The mean age and anthropometric data of patients can be seen in Table 2.

Minimum	Maximum	Median	Mean	N
17	46	33	32.2	205
82	206	122	125.1	205
125	181	164	164.1	205
40	71	46	47	205

Table 2: Age and Anthropometric Data.

Of the 205 patient who were reviewed, 58 patients (28%) were ASA class II and 146 patients were ASA class III (71%) while only 1 patient was ASA class IV (1%), see Table 3. Also, it can be seen in table 3 that significant proportion of women had comorbidities including diabetes mellitus, hypertension and asthma. In addition, 12 parturients had multiple pregnancy and 3 had placenta previa.

ASA Class	Number (%)
II	58 (28.3)
III	146 (71.2)
IV	1 (0.5)
Co-morbidities	Number (%)
Hypertension	42 (20.5)
Diabetes Mellitus	36 (17.6)
Asthma	24 (11.7)
Hypothyroidism	14 (6.8)
Obstructive Sleep Apnea	6 (2.9)
DVT	4 (2.0)
Scoliosis	3 (1.5)
Others*	34 (16.6)
Multiple Pregnancy	12 (5.9)
Placenta Previa	3 (1.5)

Table 3: Patient's ASA Classes & Co-morbidities.

*Others: includes SVT, Cardiomyopathy, Aortic dilatation, Thrombocytopenia, Thalassemia, Coagulation disorders, Depression, Anxiety, Bipolar disorder, Substance abuse, Pituitary tumour, Bell's palsy, Kidney disease, Fatty liver disease, Muscle disease and Pelvic inflammatory disease.

100 (49%) of our reviewed patients had no previous cesarean sections and 84 (41%) had 1 previous cesarean section, while 18 (9%) of them had 2 previous cesarean sections and 2 (1%) had 3 previous cesarean sections, whereas only 1 had 4 previous cesarean deliveries.

Anesthetics were conducted by the attending staff anesthesiologist or senior anesthesia resident under supervision of the staff anesthesiologist. Spinal anesthesia was given in 151 of the reviewed cases (74%) and epidural anesthesia was the anesthetic technique in 26 parturients (13%). Combined Spinal-Epidural (CSE) was given in 20 parturients (10%) - usual spinal doses were given while epidural was used only to extend the block if needed, while general anesthesia was needed to be given in 8 parturients (4%) due to difficulty to put the spinal or total patient refusal to neuraxial block. Bupivacaine 0.75% was the only local anesthetic used in the spinal anesthesia (dose 11 mg ∓1.5) in addition to fentanyl (10-25 mcg) and preservative-free morphine (50-200 mcg).

Statistical analysis of fetal data is presented in Table 4.

The incidence of significant intra-operative hypotension after regional anesthesia in our patient's cohort was 65% (128 patients) while the incidence of bradycardia requiring treatment with anticholinergic medications was 3% (6 patients). The incidence of

Variable	N	Mean	Standard Deviation	Minimum	Lower Quartile	Median	Upper Quartile	Maximum
Baby birth weight G	220	3465.5	754.97	551	3074	3480.5	3993.5	5654
Apgar 1	220	7.77	1.89	0	7	9	9	10
Apgar 5	220	8.83	0.8	0	9	9	9	10
Cord pH	220	7.23	0.15	6.91	7.18	7.24	7.27	7.4

Table 4: Babies Birth Weight, Apgar Scores and Cord blood pH.

intra-operative nausea and vomiting was 14% (28 patients). Supplemental intra-operative IV analgesia was required in 13% (24 patients) of the patients who had regional anesthetic techniques. Extra-length needles - 120 mm (Spinal or epidural) were required in 27% (54 patients) of patients. There were three occasions where spinal anesthetic technique needed to be converted to general anesthesia due to wearing of spinal block effect.

Significant postoperative hypotension was detected in 10% (20 patients) of patients; all of them were treated by giving crystalloid or colloid fluid boluses, while nausea and vomiting were present postoperatively in 17% (20 patients) of patients where Ondansetron was given. Despite our hospital's routine practice of giving acetaminophen and one NSAID's medication once the parturient in the PACU after cesarean section, these analgesics were not given in 34% (69 patients) of our patients and pain was treated with parenteral opioids. The mean stay time in the PACU was 2.3 hours.

Spinal/CSE vs. epidural technique

Comparison of the spinal and CSE techniques group with the epidural group demonstrated a significantly higher incidence of intra-operative hypotension in the first group (Spinal & CSE) 107 patients (67.7%) compared to 8 patients (34.8%) in epidural group, p-value = 0.0022 (Table 5). There was, however, no observed statistically significant difference in other intra-operative complications such as bradycardia, nausea and vomiting, intra-operative fluids (crystalloids and colloids), and extra-analgesic requirements, Additionally, no significant differences were noted in post-operative complications including hypotension, nausea and vomiting, bradycardia and duration of PACU stay between the two groups. From a neonate perspective, no statistically significant differences were noted between the two groups in terms of fetal cord blood pH and APGAR scores at 1 and 5 minutes post-delivery.

Type of Anesthesia	Significant Hypotension		Total	P Value
	No	Yes		
Epidural N (%)	15 65.22%	8 34.78%	23	
Spinal & CSE N (%)	51 32.28%	107 67.72%	158	0.0022
Total (No.)	66	115	181	

Table 5: Significant Hypotension according to Anesthetic Technique.

Comparison of two BMI groups

The cohort was divided, according to the delivery BMI, into 2 groups: parturients with BMI 40-49.9 (morbidly obese) and the group of parturients with BMI of 50 or more (super morbidly obese). By comparing and analysing the data from the two groups, there was a significant difference in the number of attempts at needle placement for regional anesthesia, p-value = 0.0255. Also there was a statistically significant difference in the mean surgery time between the two groups, p-value < 0.0001. The amount of intra-operative

crystalloid and colloid fluids was also significantly higher in the super morbidly obese group, p-value = 0.0007 (Table 6).

	Morbidly Obese (MO) (BMI 40-49.9)	Super Morbidly Obese (SMO) (BMI ≥ 50)	P value
Mean of No. of Needle placement Attempts	2.02	2.61	0.0255
Mean Surgical Time (min)	86.6	107.55	0.0001
Mean Intra-operative Crystalloids volume (ml)	1699	1887	0.0376
Patients Required Intra-operative Colloids (%)	12.6	33.9	0.0007

Table 6: Comparison between Classes of Morbid Obesity - Significant Results.

In our statistical analysis we did not find significant differences in the intraoperative estimated blood loss, intra- and postoperative hypotension, bradycardia, nausea and vomiting or extra-analgesic requirements between morbidly obese and super morbidly obese patients. Additionally, the PACU stay time, post-operative fluids requirement, babies' birth weights, fetal cord blood pH and Apgar scores at 1 and 5 minutes were not significantly different between the two groups.

Discussion

Obesity is a multi-systemic disorder that results in physiological changes superimposed on the systemic functional changes of pregnant women. It can bring about increase in both maternal and perinatal morbidity and mortality [11]. Of the most substantially important changes that have implications on the anesthesia-related side effects are the cardio-pulmonary effects of obesity. Both oxygen consumption and carbon dioxide production have linear relationship with body weight. Because of the augmented fat mass in the chest and abdominal walls and the upward retraction of this adipose tissue caused by supine position, respiratory difficulty and even oxygen desaturation can be experienced by the obese pregnant woman as these factors further lower the functional residual capacity, expiratory and inspiratory reserve volumes and chest wall compliance leading to worsening of the V/Q relationship [12-14].

Obesity can cause further increase in the already raised cardiac output of the pregnant woman (normally reaches approximately 50% greater than the pre-pregnant volume in second & third trimesters). On the other hand, obesity impairs the reduction in the afterload that is associated with pregnancy by increasing peripheral vascular resistance and greater conduit artery stiffness. This can lead to potentially decreased cardiac functional reserves in obese patients and puts the obese parturient at particular risk. Also, obesity has been mentioned as a risk factor for peripartum cardiomyopathy [15-18].

Obesity can add significantly to both obstetric and anesthetic associated morbidity [19]. Obese parturients have a tendency to labour abnormally, which may contribute to increased instrumental and caesarean delivery (2 to 4 fold increase) [9,10,20,21]. Considerable challenges are faced by anesthesiologists when helping

to deliver these patients by caesarean: these patients are more likely to have technical challenges with airway access, ease of intubation, intravenous access, spinal or epidural placement, and analgesic/anesthetic success with regional techniques, not to mention prolonged operation times and difficulty with adequate left uterine displacement positioning on the operating table [9,19,20,22,23].

Regional anesthesia (spinal or epidural) is the technique of choice when it comes to cesarean delivery. It is the anesthetic route proven to be the safest for the parturient while at the same time providing optimal post-operative pain control. This is true in both normal weight and bariatric parturients [24-27]. The first inference that can be made from our bariatric parturient study sample is that spinal anesthesia continues to be used more often than CSE and epidural anesthesia for caesarean sections even in the morbidly obese parturients. In our studied cohort of patients, regional anesthesia was the chosen anesthetic technique in 96% of the cases, while spinal anesthesia was preferred to be used in 74% of the cases.

One of the common and well-known side effects of spinal anesthesia however is hypotension (incidence between 53-65%) [27,28]. We observed that the spinal anesthesia technique (spinal alone and the spinal component of a CSE) resulted in more intraoperative hypotension (77%) compared to the epidural technique (35%). The drop in blood pressure can be caused by either significant vasodilatation from the sympathetic blockade, or due to positioning inadequacies leading to aortocaval compression. In the normal weight patient, the blood pressure change can be usually compensated for quickly by minor position changes followed by fluid administration and vasopressor medications if necessary. Unfortunately, in the significantly overweight patient this complication can be much more challenging, which might be due to the difficulty to achieve the optimum positioning of the bariatric parturient quickly. In fact some studies even identified that obesity alone may be a risk factor for hypotension to develop after spinal anesthesia [27,28]. This is due to increased intra-abdominal fat and weight causing aortocaval compression with inherent decreased blood return to the heart. Slow titration of an epidural for these women may allow for better blood pressure compensation with fluid administration and repositioning before hypotension is experienced.

Additionally, maternal bradycardia can be concurrent with hypotension, both of which may lead to the deleterious side effects of intra-operative nausea, vomiting, and fetal academia [27,29,30]. The overall incidence of intraoperative bradycardia in our studied group of patients was 3.4% (7 patients), while 28 patients (13.66%) experienced nausea and vomiting during the surgery, and 34 patients (16.59%) in the early postoperative period.

Also, we can extrapolate, as might be anticipated, that the super morbidly obese (BMI ≥50) parturients seemed to be more challenging to manage than the morbidly obese parturients (BMI 40-49.9). They had more attempts at needle placement for regional anesthesia [SMO vs. MO number of attempts was 2.6 vs. 2.0 (p-value 0.0255)], more fluids administered (likely to prevent intra-operative hypotension and/or because of the length of the procedure) and required longer times to complete the surgery [SMO vs. MO mean surgical time was 107.55 min vs. 86.6 min (p-value 0.0001)]. The implications here are twofold. Higher grades of obesity (super-morbid obesity) should be a risk factor for potential perioperative morbidity added to the recognized and mentioned risks of being overweight or obese in pregnancy. Finally, due consideration should be paid pre-operatively

to adjusting the anesthetic technique in these patients. It is desirable to avoid the potentially deleterious effects of either adding intravenous narcotic adjuncts (over sedation, apnea, aspiration) or intra-operative conversion to a general anesthetic (difficult airway access in a difficult position, rapid desaturation) in order to keep the patient comfortable for the duration of the surgery. Perhaps an appropriately placed (e.g., upper lumbar or lower thoracic) epidural technique is a more proficient route of anesthesia in these parturients.

In conclusion, our study found that spinal anesthesia continued to be the preferred technique to provide anesthesia for cesarean sections in morbidly obese parturients. It resulted in higher incidence of intraoperative hypotension than other regional techniques. Those women with delivery BMI ≥50 appeared to be prone to more challenges during cesarean deliveries. This was evidenced by the higher mean surgical times, more placement attempts of regional anesthesia and larger intra-operative IV fluid volumes. Due consideration should be paid to adjusting the anesthetic technique in bariatric parturients. In addition, anesthesia providers should take advantage of interventions and facilities that aid in performing central regional techniques, as these women present a significant challenge to regional access. For example, the use of spine ultrasound, which should be practiced and implemented more often in bariatric parturients in pursuit of performing regional techniques most efficiently. A well-organized, randomized controlled trial could prove beneficial in validating the most profitable anesthetic technique for bariatric parturients that fosters safety for both mother and baby.

The limitation of our study comes from being a retrospective review with missing data in some patients and the inability to randomize patients into specific groups and the lack of controlled group to compare our cohort to it.

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