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Effect of BMI On Subarachnoid Depth And Spinal Anesthesia Techniquein Elective Cesarean Section

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ABSTRACT

Objective: To determine the effect of Body Mass Index on depth of Subarachnoid Block and technique of Spinal Anesthesia in Elective Cesarean Section.

Study Design: Prospective longitudinal study

Place and Duration of Study: Combined Military Hospital Rawalpindi Pakistan, From Mar - Sep 2022.

Methodology: A total of 60 participants were randomly distributed in two uniform groups with BMI cut off value of 45 between the two. Age of the patients included in the study was from 18-40 years with single pregnancy planned for elective cesarean section. Under standardized technique, spinal anesthesia was given to patients and various characteristics of block, hemodynamic variables and side effects were recorded.

Results: Total 60 patients were recruited in the research with 30 patients in each group. Mean age of patients in group A was 33.83±4.75 years while in group B was 35.57±2.46 years. Episodes of nausea and vomiting were greater in group B as compared to group A. Hypotension episodes and time to achieve blockade at the level of T6 dermatome between two groups were significant with a *p*-value of <0.05.

Conclusion: The level of anesthesia achieved in patients with BMI >45 is higher, the onset is rapid with more episodes of hypotension and requirement of vasopressors as compared to patients with BMI <45.

Keywords: Nausea, Vomiting, Hypotension.

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INTRODUCTION

Neuraxial anesthesia especially spinal anesthesia is the preferred anesthetic technique in elective cesarean sections primarily because it has fewer complications and risks in comparison to general anesthesia.[1] Neuraxial Anesthesia can be given both as single shot spinal block or combined spinal-epidural technique, which in some trails have shown better cardiovascular stability and depth when compared to single shot spinal anesthesia. Irrespective of the technique used, the main aim of anesthesia revolves around the maternal comfort and fetal well-being, inculcating plans to minimize morbidity and mortality.[2] Spinal anesthesia or Subarchanoid block has the unique advantage of inducing profound nerve block in large portion of the body with a relatively lesser technical knowledge and a mere simple injection of small amount of local anaesthetic. Compared to the Epidural anesthesia, this is much easier to perform and has a very high success rate when performed correctly. Its advantages over epidural include quick onset, dense block and reliable amount of anesthesia with a lesser skill level required. It also produces lesser incidence of inadvertent intravascular injection causing Local Anesthesia Systemic Toxicity. Epidural on the other hand the advantage of lesser hemodynamic instability, lesser incidence of Post-Dural Puncture Headache and better control over the anesthesia with the ability of continuously topping up thjs epidural when required, even in the post-operative period.[3,4]

Hyperbaric bupivacaine is the most used drug for spinal anesthesia as it provides adequate and quick onset anesthesia. However, when used alone in cesarean sections, the doses used can increase risk of hemodynamic adverse effects. Hence it is often combined with different adjuvants, most commonly opioids, to decrease total dose and side effects of bupivacaine.[5] Other adjuvants include dexmedetomidine, clonidine, ketamine, Magnesium sulfate etc. Due to the presence of Gravid Uterus, Inferior Vena Cava is compressed after the 20th week causing engorgement of the epidural venous plexus leading to a compressed sub-arachanoid space.

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Moreover, increased fat deposition in the back and around the spinal canal further reduced this space with a decreased Cerebrospinal Fluid volume. It is also postulated that increased amount of Progesterone and their receptor upregulation leads to an increased sensitivity to local anesthetics in pregnancy. Pregnancy also exacerbates the natural lordosis of spine, elevating it to the level of T5. Hence, it is a general notion to reduce the volume of local anesthetics to one-third in pregnancy and obese patients.[6,7]

As with any invasive procedure, neuraxial anesthesia is also associated with certain complications including hypotension, bradycardia, post dural puncture headache, nausea and vomiting, urinary retention, epidural abscess, and hematoma.[8] Maternal hypotension is one of the common complications of spinal anesthesia with adverse effects on baby as well and multiple studies have been conducted on its prevention and management.

As the local anesthetic flows cephalad, it produces sensory as well as motor block. The commonest method of assessment used in daily practice is the "Bromage Scale". It is a crude but a very simple and non-invasive method to assess the spread and the degree of block in the lumbo-sacral region. Usually, the surgery below the groin can begin if the Bromage 3 scale is achieved. Thoracic nerve block however cannot be assessed this way and abdominal and intercostal muscle block function is only assessed through Pulmonary Function Tests. Hence, cold test using a cotton swab dipped in ethanol is usually employed.[9]

The sensory level achieved during neuraxial anesthesia can predict the incidence of hemodynamic compromise with considerably increased incidence with T4 block level or higher.[10] Studies over the years have shown multiple factors to influence spread of intrathecal anesthetic including the drug characteristics, procedure, and patient characteristics. Body Mass Index is a factor studied in association with effect on intrathecal spread of anesthetic agents and multiple trails have shown positive correlation however results are still controversial in several studies. A positive relation between obesity and spread as well as duration of spinal block is evident from several research papers. Similar results were found in other studies as well with direct correlation between patient's weight and cephalad spread of local anesthetic in spinal anesthesia.[11]

The rationale of this study is to evaluate the effect of body mass index on the sensory depth and technique of spinal anesthesia in elective cesarean section.

METHODOLOGY

This was a Prospective longitudinal study at Combined Military Hospital Rawalpindi for a period of 06 months i.e., from 05th March 2022 to 05th September 2022 after receiving acceptance from the review ethical committee of the hospital under ERB Ser No. 266.

Sample size calculation was done using WHO sample size calculator with a confidence interval of 95%, 90% power of study, standard deviation of 0.63, mean time taken to achieve block at the level of T6 when BMI < 30kg/m^2 was 3.55 minutes and mean time was 2.78 minutes when BMI> 45kg/m^2 as per study conducted by Elmeliegy M *et al*.[1] The estimated sample size for each group was calculated as 15 which was adjusted as n=60 with 30 patients in each group via randomized sampling technique as per the minimum requirement of research study.

Inclusion Criteria: A total of 60 participants were randomly distributed in two uniform groups Group – A (BMI < 45) and Group – B (BMI > 45) with 30 patients in each group. Age of the patients included in the study was from 18-40 who belonged to American Society of Anesthesiologist (ASA) grade II with single pregnancy planned for Elective Cesarean Section.

Exclusion Criteria: Patients were excluded if they had history of 2 or more Cesarean Sections in the past, hypertensive disorders of pregnancy, twin pregnancies, contraindication to neuraxial blockade, placental abnormality or unwilling for the research study.[1]

Preoperatively patients presenting for Elective Cesarean Sections were prepared after taking a detailed history, examination, and assessment of laboratory investigations in preoperative clinics as per our institutional protocol followed by obtaining a written informed consent from patients. A night before the procedure participants were kept Nil Per Oral and shifted to Operation Theatre on the day of surgery. In the Operation Theatre, patients were monitored by using pulse oximetry probe, non-invasive blood pressure cuff and electrocardiography electrodes. Baseline vital signs were recorded, and patients were preloaded with crystalloids @ 10ml/kg in left lateral position. Under aseptic measures while

the patient was in sitting position, the spine was examined and interspace between 3rd and 4th lumbar vertebrae was identified. Using 2% plain lignocaine, local anesthesia infiltration at the selected site was done for anesthetizing the area. After confirmation of free flow of cerebrospinal flui, using a 25- gauge Quicnke's spinal needle, 12.5 mg of bupivacaine was administered to the patient. Patient was placed in supine position with a wedge placed under right hip for prevention of aortocaval compression. The level of sensory blockade was assessed by using pin prick sensation in the midclavicular line after every 2 minutes for the initial 10 minutes then after every 5 mins. Motor blockade was assessed using Bromage scoring (0 =able to move all joints of the lower limb; 1 = unable to move hip joint but able to move knee and ankle joints; 2 = unable to move hip and knee joints but moving ankle joints; 3 = unable to move hip, knee, and ankle joints) at 2-minute intervals. Recorded variables included height, weight, hemodynamic parameters (heart rate, blood pressure, oxygen saturation, temperature), time to achieve sensory blockade at the level of T6. Complications during the period like nausea and vomiting were recorded and treated with antiemetic medication (Injection Metoclopramide 10mg intravenous stat). Blood pressure readings below 20% of the baseline was recorded as an event of hypotension which was treated with rescue medication of injection phenylephrine 50mcg intravenous bolus.

All the data was tabulated in data management software statistical package for the social sciences (SPSS) version 23 and analyzed. Analysis of quantitative data was done by using Mean±SD using chi square test while frequencies and percentages were computed for qualitative variables and independent sample t-test used to evaluate significant results. Comparison was considered significant if *p*-value <0.05.

RESULTS

Total 60 patients were recruited in the research with 30 patients in each group. Mean age of patients in group A was 33.83±4.75 years while in group B was 35.57±2.46 years. Out of 60 patients, the number of patients from ASA I were 46(76.6%) while 14(23.3%) belonged to ASA II class. Distribution of patients on basis of age, height and weight are shown in Table-I. Episodes of nausea and vomiting were greater in group B as compared to group A with insignificant results as shown in Table-II. Hypotension episodes (Table-II) and time to reach T6 between two groups (Table-III) were significant with a *p*-value of 0.007 and 0.001 respectively.

Table–I: Physical Characteristics (n=60)

	Group 'A' (n=30) Mean±SD	Group 'B' (n=30) Mean±SD	*p*-value
Age	33.83±4.75	35.57±2.46	0.81
Height in Inches	64.60±3.02	64.83±3.19	0.772
Weight in kgs	86.13±11.16	137.57±10.39	0.000

Table–II: Episodes of Nausea, Vomiting and Hypotension (n = 60)

	Group 'A' (n = 30)	Group 'B' (n =30)	*p*- value
Nausea	06(20.0%)	09(30.0%)	0.371
Vomiting	02(6.7%)	03(10.0%)	0.640
Hypotension	06(20.0%)	16(53.3%)	0.007

Table–III: Time to Achieve T6 block Between Groups (n=60)

Time taken to achieve T6 blockade	Group 'A' (n = 30) Mean±SD	Group 'B' (n =30) Mean±SD	*p*-value
Mean time (minutes)	3.52±0.71	2.94 ± 0.90	0.001

DISCUSSION

The purpose of this research activity was to investigate the impact of obesity on the depth of anesthesia and the technique of spinal anesthesia in obese patients with BMI >45 as compared to patients with BMI <45. Results of the study revealed that the height of sensory block in obese patients was achieved faster with more episodes of hypotension in patients with BMI >45.

In pregnancy the anatomical, physiological, and pharmacological changes leads to greater sensitivity for anesthetic agents and the recommended dose of hyperbaric bupivacaine for spinal anesthesia is reduced. The question of whether the dose of bupivacaine in obesity is still unanswered. Our study reveals greater episodes of hypotension with higher level of block achieved in lesser time when the patients were obese as compared to when BMI was <45 implies to decrease the dose of local anesthetic in obese patients.

The most common technique used for anesthesia during cesarean section remains spinal anesthesia. Hypotension is the most common side effect of the procedure as it causes sympatholysis. Multimodal technique is used to treat hypotension including, fluids administration, positional changes to decrease compression of inferior vena cava, use of vasopressors

and using a smaller dose in patients susceptible to hypotension.[2]

In one study the block time for combined spinal epidural technique was greater than single shot spinal anesthesia employed in pregnant patients with no significant differences in complications after both the procedures.[3]

Use of opioids with local anesthetics in neuraxial anesthesia is commonly employed for a longer period of analgesia. Ferrarezi *et al*., found the use of fentanyl with bupivacaine proved useful in providing analgesia for a longer period with lesser side effects.[5]

Drugs have been advocated for use to achieve faster sensory and motor blocks. A comparative study revealed faster achievement of sensory and motor block when bupivacaine was used with ketamine as compared to when bupivacaine and magnesium sulphate was used. In addition to this the episodes of hypotension were lesser in ketamine group with lesser requirement of vasopressors intraoperatively.[7]

Like our results other studies show that the level of the block if achieved at a faster rate will result in more episodes of hypotension hence greater requirement of vasopressors. Study done by Zhang et al revealed that rapid achievement of a higher block in pregnant patients was a positive predictor of greater episodes of hypotension.[13]

Similar to the results achieved by our study another research signifies a significant relationship of anthropometrics with level of the spinal block and the episodes of hypotension with faster achievement of a higher level of block and more episodes of hypotension in obese patients.[15] Another study done by Kim HJ et al showed a significant impact of bupivacaine administered in obese patients with a prolong and deep block as compared to patients who were non obese.[16-18] Hence our study proves a significant impact of obesity on spinal anesthesia with greater risk of hypotension and higher level of block in morbidly obese patients.

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LIMITATIONS OF STUDY

None

CONCLUSION

The extent of anesthesia achieved in patients with BMI >45 is rapid and higher with more episodes of hypotension and requirement of vasopressors as compared to patients with BMI <45.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

MSS & QR: Data acquisition, data analysis, critical review, approval of the final version to be published.

OAM & HB: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

AA & MSF: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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