

Does the Type of Anesthesia for Caesarean Section Affect the Neonate? A Non-Randomized Observational Study Comparing Spinal versus General Anesthesia

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Received date: May 17, 2016; Accepted date: December 06, 2016; Published date: December 12, 2016

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Abstract

The influences on neonates due to choice of anesthesia for cesarean section deliveries, general versus spinal were the focus of this prospective non randomized observational study.

Aims and objectives: To study the effects of choice of obstetric anesthesia during Cesarean Section (General (GA) or spinal (SA): on mothers by assessing Mean arterial Blood pressure changes and Time to delivery from initiation of Anesthesia, & Uterine Incision: on neonates by assessing Apgar Scores and Umbilical cord blood parameters.

Material and methods: Two groups of 20 expectant mothers each, posted for elective caesarean sections ASA 1 & 2. Group A: SA Group B: GA. Informed consent, IERB approval, Results: The two groups were comparable in terms of age, weight, pre-operative mean arterial pressure and gravid status. The mean speed of surgery in minutes was significantly faster under General Anesthesia (8.65 to 17.6) when measured from induction of anesthesia to delivery time, and (1.65 to 2.4) when measured from uterine incision to delivery time. The upper limit of block of spinal anesthesia was variable, but mostly centered around T4, T6. The maximum values of Fluctuations in the Blood pressure in the two groups showed that the SA group had a drop in the mean arterial pressure up to 54 mmHg, while the GA group showed a rise in the mean arterial pressure up to 107 mmHg. The neonatal cord blood parameters across the two groups showed no significant differences in pH, PCO₂, HCO₃, and base excess. However umbilical cord venous blood oxygenation (35.86) and Oxygen saturation (58.71) were significantly better when delivery was under GA in comparison with SA (26.59 and 44.58).

Discussion: The benefits of a faster surgical time achieved under General anesthesia were not quantifiable as no difference in apgar score in the neonates of the two groups at 1 or 5 minute. The fluctuations in Blood pressure likewise did not translate to evidence of fetal hypoxia. The increased blood oxygenation as a consequence of controlled anesthesia was the only noteworthy finding in the cord blood analysis.

Conclusion: There were no statistically significant changes on the apgar score of neonates or their blood biochemistry, if the choice of anesthesia for cesarean section were general or spinal. Cord blood oxygenation was higher with general anesthesia.

Keywords: Anesthesia for caesarean section; Obstetric anesthesia; Effect on neonates; General anesthesia; Spinal anesthesia

Introduction

The choice of anesthesia for obstetric anesthesia has been traditionally influenced by patient and physician preferences.

Maternal safety, the absence of narcotic effects, avoidance of inhalant anesthesia, or intra venous drugs leading to an awake mother, who can initiate lactation early and with less pain due to post-operative residual analgesia and hence a better psychological outcome, are compelling arguments favouring use of regional anesthesia.

Epidural anesthesia or Spinal with epidural anesthesia is gradually becoming the preferred anesthesia choice in obstetric anesthesia. Spinal anesthesia is still a mainstay in Caesarean Section as it avoids a

general anaesthetic with concomitant risks of failed intubation especially in anatomical abnormalities, and risks of ventilation in respiratory diseases. The mother is conscious and the partner is able to be present at the birth of the child. The post-operative analgesia from intrathecally administered opioids and non-steroidal anti-inflammatory drugs are also good. Ease of administration, improved needles which reduce the post puncture headache and faster onset time of anesthesia favour the use of spinal anesthesia

General Anesthesia with its superior control over ventilation, avoidance of hypotension seen with spinal anesthesia, speed of induction, and lack of awareness of the perioperative period is preferred in emergency situations and in selected elective procedures [1].

Apocryphal anecdotes attribute to Dr Walter Channing of Harvard in 1847 the first attempt to report on the effects of anesthesia on the

neonate by crudely attempted to smell ether at the cut ends of the cords stating that there were negligible effects on the neonate! [2]. The influences on neonates due to anesthesia for cesarean section deliveries is usually not a factor in the choice, and it is maybe time to revisit this issue. Neonatal impact needs to be considered in the decision paradigm, especially as advances in anesthesia and monitoring have altered the reality of practice of obstetric anesthesia.

In our tertiary level referral hospital setting we conducted this pilot prospective non randomized observational study to look at this aspect of caesarean anesthesia.

Aims and Objectives

To study the effects of choice of obstetric anesthesia during Caesarean Section (General (GA) or spinal (SA)), on mothers by assessing

Mean arterial Blood pressure changes.

Time to delivery from initiation of Anesthesia & Uterine Incision

To study the effects of choice of obstetric anesthesia (GA vs. SA) in Neonates by assessing

i) Apgar Scores

ii) Umbilical cord blood parameters: such as: pH, PCO₂, PO₂, HCO₃, etc.

Materials and Methods

After obtaining Institutional Ethical Board clearance (IERB/RS/1/1/132/11) Intra mural funding for the study was obtained from the St Johns Hospital Research Society, (PO167).

Two groups of 20 expectant mothers each, posted for elective caesarean sections who were ASA 1 & 2 were included in the study. The choice of anesthesia was made after discussion with the patient and obstetrician. Inclusion in the two arms of the study was post hoc, and not randomized. Informed consent for the study was obtained from the mothers.

Patients undergoing emergency caesarean section due to maternal or fetal causes were excluded from this study. Epidural anesthesia and spinal with epidural is a feature of a parallel study hence not reported in this analysis.

Group A: Spinal anesthesia

Group B: General anesthesia

The anesthesia techniques in both followed standard institutional guidelines and no deviations were noted.

For general anesthesia after preoxygenation for 3 minutes, intravenous Rapid sequence induction with thiopentone sodium (5 mg/kg), succinyl choline (2 mg/kg), followed by intubation, and maintained with 50% oxygen, nitrous oxide and isoflurane mixture, and atracurium (0.3 mg/kg body weight initially, with bolus of 10 mg). After delivery, and clamping of the umbilical cord, oxytocin drip (20 units in 500 ml normal saline) and Fentanyl 2 mcg/kg was administered. Patients were reversed with neostigmine 50 mcg/kg and glycopyrrolate 10 mcg/kg and extubated.

For spinal anesthesia after preloading with normal saline, 10 ml/kg body weight, 2 ml of 0.5% hyperbaric bupivacaine was introduced intrathecally at L 3-4 space, via a 25 gauge spinal needle. Oxygenation

at 5 litre/minute with mask was administered during the delivery. Vasopressors ephedrine (6 mg boluses) was given when Mean Arterial Pressure (MAP) dropped to less than 20% of the base line.

Documentation of maternal and fetal parameters, umbilical cord venous blood readings were done as per our standard institutional proforma. The blood pressure (NIBP automated) and heart rate was recorded every minute for the first five minutes, and thereafter at 5 minute intervals till completion of the procedure. Maternal factors such as Previous LSCS, Obesity (BMI), maternal age at delivery, week of pregnancy at time of delivery, smoking status in the mother, and birth weight in the neonate were identified as potential Confounders. Multivariate regression analysis, with adjusted odds ratio was calculated. The sample size in each arm was 20, as this was a pilot study to detect trends in our institution with current standardized protocols. Descriptive statistics were reported using mean and Standard Deviation for the continuous variables, and number and percentages for the categorical variables. Inferential statistics used Independent Sample T Test between the two groups for comparison of clinical and demographic parameters. P value less than 5% was considered as statistically significant and multivariate regression analysis for confounders using SPSS version 17.1.

Results

The two groups of expectant mothers chosen for the study were comparable in terms of age, weight, pre-operative mean arterial pressure and gravid status (Table 1).

| Parameters | | Spinal Anesthesia | General Anesthesia |
|--------------------------------|--|-------------------|--------------------|
| Age in Years | | | |
| Mean | | 28.35 | 26.55 |
| Standard Deviation | | 3.376 | 4.915(SED: 1.3) |
| Range | | 22-34 | 20-35 |
| Weight in Kg | | | |
| Mean | | 61.5 | 53.25 |
| Standard Deviation | | 11.56 | 4.79 (SED: 2.79) |
| Range | | 40-83 | 45-61 |
| Mean arterial pressure (mm Hg) | | | |
| Mean | | 84.95 | 86.7 |
| Standard Deviation | | 8.153 | 5.4 |
| Range | | 68-100 | 76-96 |
| Gravid status | | | |
| I | | 5 | 11 |
| II | | 10 | 4 |
| III | | 5 | 4 |
| IV | | 0 | 1 |

Table 1: Maternal Demographics.

Did the choice of anesthesia affect the surgical time?

Two parameters were studied to determine the influence of anesthesia on surgical time, the time from induction of anesthesia to delivery time, and the time from uterine incision to delivery time. (Table 2). The speed of surgery in our study was significantly faster

under General Anesthesia (8.65 mins mean to 17.6 mins mean) when measured from induction of anesthesia to delivery time, and likewise (1.65 min to 2.4 min mean) when measured from uterine incision to delivery time.

| Parameters | | Spinal Anesthesia | General Anesthesia |
|--|--|-------------------|-----------------------|
| Anesthesia to Delivery time in minutes | | | |
| Mean | | 17.6 | 8.65 |
| Standard Deviation | | 4.99 | 4.46 (P value 0.0001) |
| Uterine Incision to Delivery Time | | | |
| Mean | | 2.4 | 1.65 |
| Standard Deviation | | 1.31 | 0.87 (P value 0.041) |

Table 2: Maternal Demographics.

Did the Level of block in Spinal Anesthesia alter the maximum fluctuation in Blood pressure?

The upper limit of block of spinal anesthesia was variable, but mostly centered around T4, T6. The drop in Blood pressure as an average from the base line did not appear to be related to the level of block (Table 3).

| Level of Block | No of cases | Drop in BP (Avg) from Baseline |
|----------------|-------------|--------------------------------|
| T2 | 1 | 60 mm |
| T4 | 6 | 58.2 mm |
| T6 | 10 | 53.5 mm |
| T8 | 3 | 57.0 mm |

Table 3: Upper limit of spinal anesthesia block.

Did the fluctuations from the base line of mean blood pressure differ significantly between the two groups?

The maximum values of Fluctuations in the Blood pressure in the two groups during the course of the surgery were noted in both groups. The mean of these values showed that the Spinal anesthesia group as expected showed a drop in the mean arterial pressure up to 54 mm of Hg, while the General anesthesia group showed a gain in the mean arterial pressure up to 107 mm of Hg (Table 4).

| Maximum fluctuation from Base line Mean Art Pressure | Spinal Anesthesia | General Anesthesia |
|--|-------------------|--------------------|
| Mean | 54.6 | 107.45 |
| Standard Deviation | 8.623 | 5.482 |

Table 4: Maximum fluctuation from Base line Mean Art Pressure.

Did the choice of anesthesia have an effect on the neonates?

The neonatal apgar scores were normal both at one minute and 5 minutes in both groups studied, and there were consequently no significant differences across the two methods of anesthesia adopted for cesarean section (Table 5).

| | Spinal Anesthesia | General Anesthesia |
|--------------------|-------------------|--------------------|
| At one minute | | |
| Mean | 8 | 7.95 |
| Standard Deviation | 0.27 | 0.39 |
| At 5 minutes | | |
| Mean | 9.1 | 9 |
| Standard Deviation | 0.304 | 0.4 |

Table 5: Neonatal Apgar scores.

Did the choice of anesthesia affect the Umbilical cord blood parameters?

The neonatal cord blood parameters across the two groups were biochemically similar. There were no significant differences noted in pH, pCO₂, HCO₃, and base excess across the two groups of neonates (Table 6).

| | S.A | G.A |
|------------------------------------|------------|------------|
| pH (Mean/S D) | 7.32/.054 | 7.31/.049 |
| pCO ₂ (Mean/S D) mm/hg | 43.73/7.21 | 45.75/8.41 |
| HCO ₃ (Mean/S D) mmol/L | 22.16/2.9 | 22.78/2.83 |
| Base Excess (Mean/ S D) mmmol/L | 3.465/2.37 | 3.59/1.69 |

Table 6: Neonatal Biochemical parameters.

However umbilical cord blood oxygenation (35.86) and Oxygen saturation (58.71) were significantly better in the group delivered under general anesthesia in comparison with those values of the group delivered under spinal anesthesia (26.59 and 44.58) (Table 7).

| | S.A | G.A |
|---|-------|--|
| PO ₂ in mm of Hg | | |
| Mean | 26.59 | 35.86 |
| S.D | 4.76 | 6.83 Significant difference P value (0.0001) |
| Oxygen Saturation percentage (SO ₂) | | |
| Mean | 44.58 | 58.71 |

Table 7: Umbilical Cord blood oxygenation.

Analgesia in the spinal anesthesia group was maintained optimally in all patients without additional narcotics. In the post-operative period after general anesthesia, addition of narcotic medication, such as pethidine 5 mg/kg was used for analgesia hence a direct comparison was not made of this parameter.

Post section lactation and feeding initiation was earlier in the Spinal Anesthesia group (Mean 1.5 h with a SD of 15), compared to the General Anesthesia group (Mean of 4 h with an SD of 45).

Did use of vasopressors in the event of fall in the BP during Spinal anesthesia affect Neonatal cord blood parameters?

Fall in maternal BP (MAP<20% from baseline) necessitated the use of vasopressors in 7 out of 20 patients. However, no significant alteration in neonatal cord blood parameters were noted.

In summary the two Groups were comparable in the Maternal Parameters pre delivery. The GA group surgical time was much faster measured both as an Initiation of anesthesia to delivery and the Uterine Incision to delivery time. In the spinal anesthesia group the Level of anesthesia mainly at T6 but a variation of the highest level was noted. The neonatal outcomes too showed no variation across Apgar Scores, pH, HCO₃, Base Excess, Lactate and PCO₂. However in the General Anesthesia group PO₂ and SO₂ were higher.

Discussion

The choice of anesthetic most appropriate for a cesarean depends on many factors, such as the urgency of the situation, maternal medical condition etc. But as better understanding of materno fetal conditions, risks and benefits have evolved; obstetric anesthesia practice too has continuously evolved. Given that the principal purpose of a caesarean section is to deliver a baby in as good or better condition than when the decision to operate is taken, it appears logical to examine critically the influence of the choice of anesthesia on the neonatal outcome [3].

This aspect has been studied earlier with equivocal results [4-7]; however, given the availability of newer anesthetic agents and more rigid protocols; the current study was an attempt to look at this aspect of obstetric anesthesia in our institutional setting.

In the present study, using comparable groups we noted that surgical time, as estimated from induction to delivery, and uterine

incision to delivery was significantly reduced in the General anesthesia group.

Krishnan et al. in their study concluded that delivery should be completed within 6-8 minutes after GA induction to prevent neonatal resp depression due to inhalant gas [6]. Evans et al. while noting the incidence of respiratory depression in children born of a general anesthesia attributed it to the effect of nitrous oxide crossing the placenta in case of a delay in delivery [3]. Kamat et al. noted a lowering of Apgar score in prolonged delivery time [5].

In our study the mean time from Initiation of anesthesia to delivery was 8.6 mins in the G.A group but no significant changes in Apgar score were noted when compared to the SA group with a mean time of 17.6 mins.

This finding is similar to what was noted by authors earlier [5,6]. The precise significance of this negative correlation can be questioned, given the lack of adverse effects on the neonate even if there were a surgical delay given controlled conditions in modern operation suites.

The role of Oxygenation of the mother during Cesarean Section was also studied earlier, and it was noted that fetal hypoxia improved when 65% oxygen was given to mothers [7]. The lateral decubitus position was reportedly beneficial for fetal oxygenation [8].

In our study, we noted significantly higher PO₂, (35.86 mmHg) and SO₂ values (58.71 %) in GA cases, who received 50% oxygen and were delivered in left lateral position as a routine. However, as neither group had any significant alteration in Apgar scores, the significance of these findings must remain equivocal. It has been suggested that other neurobehavioural scoring systems may be more relevant than conventional Apgar Scoring in this regard [9].

The concern that hypotension the most common side effect of spinal anesthesia especially if untreated can lead to fetal acidosis because of diminished uteroplacental blood flow. Was highlighted as Fetal Acidosis is a risk for adverse neonatal outcome [10]. A pH<7 associated with neurologic and other organ damage. Some morbidity may be seen between pH=7-7 [1]. However, this has never been established in studies. In a study of 238 cases of cesarean sections, it was reported that significant neonatal acidosis, and lowered oxygenation were noted in neonates born of mothers receiving spinal anesthesia, though without evident effect on fetal wellbeing [11].

In our study too, we did not note any significant acidosis in blood gas analysis, in the group of neonates, who were delivered receiving Spinal Anesthesia even though there was significant maternal hypotension in that group.

The use of vasopressors to correct significant drop in blood pressure during spinal anesthesia did not cause significant alteration in cord blood parameters. This finding was similar to results from an earlier retrospective database analysis comparing cord blood parameters when phenylephrine was used instead of ephedrine [12].

Analysis of Ischaemic modified albumin (IMA) in cord blood as an early marker for ischemic events has been used to explore subtle alterations in blood oxygenations [13].

On the basis of our study no clear advice for a change in protocols was made in our institution. We note that though Spinal Anesthesia leads to a significant drop in BP, no significant fetal acidosis develops. However the oxygenation of the neonate is significantly better with General Anesthesia. Hence case individualisation was still recommended on the basis of the study. There were no alterations in

umbilical cord blood values across the group in this limited sample, hence no further conclusions were drawn.

Larger patient numbers, inclusion of Epidural and spinal with epidural anesthesia cases, Emergency cases, study of IMA and other ischemia markers and a longer term follow up of neonates to validate these observations are aspects being reviewed at our centre for further prospective analysis.

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