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Original Research Article

EFFECT ON THE NEWBORN OF USING MONOPOLAR CAUTERY DURING ABDOMINAL ENTRY IN CAESAREAN SECTIONS

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ABSTRACT

Background: Caesarean section is one of the most frequently performed obstetric procedures, and electrosurgical devices such as monopolar cautery are increasingly used during abdominal entry to improve hemostasis and reduce operative time.

Objective: To assess the effect on the newborn of using monopolar cautery during abdominal entry in elective cesarean sections compared with the conventional scalpel technique.

Materials and Methods: This prospective randomized case–control study was conducted at a tertiary level medical college and hospital from Jan 25 to December 25, including 100 women undergoing elective lower segment cesarean section at term.

Results: In this study of 100 patients (50 in each group), baseline characteristics were comparable between the cautery and no cautery groups.
Mean maternal age was 29.9 ± 3.8 vs 30.2 ± 4.2 years, gestational age 38.27 ± 0.69 vs 38.37 ± 0.72 weeks, and birth weight 2.95 ±0.25 vs 2.93 ± 0.26 kg. Apgar scores improved similarly from 8.40 ± 0.25 vs 8.27 ± 0.26 at 1 minute to 9.33 ± 0.67 vs 9.40 ± 0.53 at 10 minutes. Cord pH (7.29 ± 0.07 vs 7.30 ± 0.05),
lactate (2.6 ± 0.9 vs 2.4 ± 0.8 mmol/L), and glucose (76.8 ± 9.7 vs 78.3 ± 10.2 mg/dL) were comparable.
Previous LSCS was the most common indication (64% vs 62%), and NICU admissions were low (6% vs 8%).

Conclusion: The use of monopolar cautery during abdominal entry in elective cesarean sections does not adversely affect immediate neonatal outcomes. Monopolar cautery appears to be a safe and effective technique that can be used without compromising newborn well-being.

Keywords: Cesarean section, monopolar cautery, electrocautery, neonatal outcomes, Apgar score, cord blood pH.

INTRODUCTION

Caesarean section is among the most frequently performed surgical operation across the globe and a great percentage of obstetric operations in both developed and developing nations.[1] The rate of caesarean deliveries is increasing worldwide, therefore the optimization of surgical procedures to make them safer, shorter and less complicated has become one of the primary concerns in current obstetrics.[2] Although most efforts are focused on advancing maternal outcomes, the possible effects of the operative procedures on the health of newborns are also equally significant and need close consideration.[3] Caesarean section traditionally entailed the use of scalpel and scissors to cut through the abdomen tissue.[4] Nevertheless, the use of electrosurgical instruments especially monopolar cautery has become more common in incision and haemostasis. Monopolar cautery has a number of

benefits such as quick tissue dissection, enhancing the visualization of the surgical planes, minor bleeding intraoperatively, minimizing time taken in the operating room, and minimizing the use of sutures.[5] Such advantages are capable of improving the efficiency of the surgery. They also minimize maternal morbidity as the blood loss, postoperative pain and the operative fatigue for the surgeon is reduced. This results in a tendency of most surgeons to use electrocautery in skin, subcutaneous tissue, and fascial entry.[6] Although there are these benefits, there are still some concerns with the possible thermal impacts of monopolar cautery. Electrosurgical energy can produce lateral diffusion, tissue effects and generation of surgical smoke.[8] In caesarean section, an event that increases the length of time taken to complete the operation or any other factor that alters uteroplacental perfusion has a potential to disrupt foetal oxygenation.[9] Thermal stress or electrical current may have some effects on the neonatal physiological adaptation in the immediate postnatal period. These effects are mostly theoretical but they pose significant concerns about the safety of using routine electrocautery during the abdominal entry when performing an obstetric surgery.[10]

Perinatal health is critically indicated by such neonatal outcomes as Apgar scores, resuscitation requirements, the cord blood acid-base status, and hospitalization in neonatal intensive care unit (NICU). These parameters can be affected even by minor intraoperative considerations.[11] Nevertheless, all available sources have been centred on gains of using electrocautery for the woman/patient with little research on its effects on the newborns.[12] The absence of evidence especially in resource-restricted environments with wide spread practices of surgery leads to inconsistent clinical practice and confusion about the safest method of surgery both for the mother and the baby.[13] Physiologically, the period when the foetus changes its intrauterine to extrauterine life is very sensitive to even minor disruptions of oxygen supply. In caesarean section, the foetal oxygenation requires proper blood flow to the uterus till the point of delivery .[14] The factors that can decrease the placental perfusion include extended incision time, intense tissue manipulation or maternal hemodynamic unsteadiness that may lead to transient foetal hypoxia or acidosis. Theoretically, more effective and quicker abdominal entry by use of electrocautery may reduce the time between incision and delivery and lead to better neonatal outcomes. On the other hand, the opposite effect may occur because of thermal injury or delay because of cautery adjustments.[15] These contradictory possibilities underscore the necessity of conducting empirical assessment as opposed to practice based on assumptions.[16] Moreover, electrocautery produces surgical smoke which has particulate matter and chemical by-products. Even though maternal impacts of surgical smoke have been researched in other forms of surgeries, its effects on foetuses in cases of obstetric surgery have not been well established. Although there is no possibility of direct foetal exposure, any circumstance that impacts the maternal oxygen level might indirectly affect the condition of the infant.[17] The above considerations emphasize the need to research not only maternal safety but also foetal outcomes of electrosurgical methods. Caesarean sections are frequently done in emergency conditions in most health care facilities particularly in the less developed and middle-income nations where time is of the essence.[19] Methods that can help to minimize the duration of the operation can be beneficial, but the safety of the neonate is the most important. In that case, it would be necessary to develop evidence-based practices that are specific to each patient group and surgery. Nowadays, the choice to use monopolar cautery at the point of abdominal entry is significantly based on the preferences of the surgeon and not on the standard procedures and protocols that are backed by neonatal outcome measures.

Objective: To assess the effect on the newborn of using monopolar cautery during abdominal entry in elective cesarean sections compared with the conventional scalpel technique.

MATERIALS AND METHODS

This prospective, randomized, case–control study was conducted at a tertiary care medical college and hospital in Mumbai from Jan 25- December 25. The study was designed to evaluate the effect on neonatal outcomes of using monopolar cautery during abdominal entry in elective caesarean sections.

A total of 100 pregnant women scheduled for elective lower segment caesarean section (LSCS) were recruited.

Inclusion Criteria

All women with term pregnancies (≥37 weeks of gestation) undergoing elective caesarean section were considered eligible for inclusion. Participants were recruited irrespective of parity and were included if the indication for surgery was maternal request, previous lower-segment caesarean section, abnormal foetal presentation or lie or cephalopelvic disproportion. Only those women with uncomplicated singleton pregnancies and stable maternal and foetal conditions were enrolled to ensure that neonatal outcomes could be attributed primarily to the surgical technique rather than underlying obstetric or medical factors.

Exclusion Criteria

Women were excluded if additional maternal or foetal conditions that could independently influence neonatal well-being were present. These included preterm deliveries, foetuses with congenital anomalies, intrauterine growth restriction, and pregnancies complicated by maternal disorders such

as preeclampsia, diabetes mellitus, obstetric cholestasis, or other systemic illnesses that had potential to compromise foetal oxygenation or metabolic status. Cases requiring emergency caesarean section or those with anticipated intraoperative difficulties like obesity were also excluded to maintain homogeneity of the study population. Patients requiring increased intraoperative time due to presence of unexpected intraoperative events were also left out of the study.

Randomization and Group Allocation

Eligible participants were randomly assigned into two equal groups of 50 patients each using a computer-generated randomization sequence with allocation concealment through sealed opaque envelopes. Group A consisted of patients in whom monopolar cautery was used for coagulation and cutting during abdominal entry after the primary skin incision. Group B consisted of patients in whom a conventional scalpel was used for incision and haemostasis was achieved through artery or mosquito forceps and manual pressure without the use of electrocautery. Apart from the abdominal entry technique, all other surgical steps were kept identical in both groups to minimize procedural variability. The operating surgeons were one of 2 who shared the same level of experience and practiced the same intraoperative steps

Data Collection

All maternal and neonatal variables were recorded in a predesigned data collection sheet by trained staff to ensure consistency and accuracy. All participants underwent thorough preoperative evaluation, including detailed history taking, clinical examination, and routine laboratory investigations. Baseline maternal characteristics such as age, parity, gestational age, and indication for caesarean section were recorded using a structured proforma. Foetal well-being was assessed in all cases using a non-stress test (NST) immediately before surgery to ensure comparable baseline fetal status between groups.

Operative Procedure

All surgeries were performed under standardized aseptic conditions by one of 2 experienced obstetric surgeons using a uniform operative protocol. A Pfannenstiel skin incision was made in all patients, followed by entry into the abdomen according to the allocated technique. A transverse lower uterine segment incision was then performed for delivery of the foetus. Care was taken to maintain consistent operative timing and technique in both groups. Patients requiring additional instrumentation, difficult foetal extraction, or encountering intraoperative complications were excluded from analysis to prevent confounding of neonatal outcomes.

Neonatal Assessment

Immediately after delivery and delayed cord clamping, each newborn was assessed by a paediatrician who was blinded to the group allocation. Neonatal well-being was evaluated using standardized parameters. Apgar scores were recorded at 1, 5, and 10 minutes after birth. Additional assessments included measurement of axillary temperature, oxygen saturation, and umbilical cord blood pH to evaluate acid–base status. Blood glucose levels were measured 10 minutes after birth and before the first feed. The need for resuscitation, requirement for neonatal intensive care unit (NICU) admission, and the reasons for admission were also documented. These measures were used to comprehensively assess immediate neonatal outcomes and physiological adaptation. The primary outcome measures were Apgar scores and umbilical cord blood pH. Secondary outcomes included neonatal temperature stability, oxygen saturation, blood glucose levels, and NICU admission rates.

Statistical Analysis

Data were entered and analysed using Statistical Package for Social Sciences (SPSS) version
26. Continuous variables were summarized as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Comparisons between the two groups were performed using the independent samples t-test for continuous variables and the chi-square or Fisher's exact test for categorical variables. A p-value of ≤ 0.05 was considered statistically significant.

RESULTS

Data were collected from 100 patients. The mean maternal age was 29.9 ± 3.8 years in the cautery group and 30.2 ± 4.2 years in the no cautery group, with an overall mean of 30.05 ± 4.0 years. Deliveries occurred at term in both groups (38.27 ± 0.69 vs 38.37 ± 0.72 weeks), and mean birth weight was nearly identical (2.95 ± 0.25 vs 2.93 ± 0.26 kg). Obstetric profiles were similar, with gravida 2.38 ± 1.01 vs 2.44 ± 1.12 and para 1.28 ± 0.86 vs 1.31 ± 0.92. Neonatal Apgar scores showed appropriate improvement from 1 to 10 minutes in both groups, with values of 8.40 ± 0.25 vs 8.27 ± 0.26 at 1 minute and 9.33 ± 0.67 vs 9.40 ± 0.53 at 10 minutes. Vital parameters remained stable, including pulse (144.2 ± 4.9 vs 143.8 ± 5.3 beats/min), respiratory rate (48.3 ± 5.6 vs 47.9 ± 6.1 breaths/min), oxygen saturation (96.88 ± 1.59% vs 96.69 ± 1.95%), and temperature (37.70 ± 0.49°C vs 37.69 ± 0.52°C), indicating no clinically significant differences between groups.

Table 1: Baseline Maternal, Obstetric and Immediate Neonatal Characteristics (N = 100)

Variable	Cautery (n=50) Mean ± SD	No Cautery (n=50) Mean ± SD	Overall (n=100) Mean ± SD
Maternal age (years)	29.9 ± 3.8	30.2 ± 4.2	30.05 ± 4.0
Gestational age (weeks)	38.27 ± 0.69	38.37 ± 0.72	38.32 ± 0.71
Birth weight (kg)	2.95 ± 0.25	2.93 ± 0.26	2.94 ± 0.25
Gravida	2.38 ± 1.01	2.44 ± 1.12	2.41 ± 1.06
Para	1.28 ± 0.86	1.31 ± 0.92	1.30 ± 0.89
Apgar 1 min	8.40 ± 0.25	8.27 ± 0.26	8.34 ± 0.26
Apgar 5 min	8.75 ± 0.59	8.92 ± 0.58	8.84 ± 0.59
Apgar 10 min	9.33 ± 0.67	9.40 ± 0.53	9.37 ± 0.60
Pulse (beats/min)	144.2 ± 4.9	143.8 ± 5.3	144.0 ± 5.1
Respiratory rate (breaths/min)	48.3 ± 5.6	47.9 ± 6.1	48.1 ± 5.8
Oxygen saturation (%)	96.88 ± 1.59	96.69 ± 1.95	96.79 ± 1.77
Temperature (°C)	37.70 ± 0.49	37.69 ± 0.52	37.70 ± 0.50

Mean cord blood pH was 7.29 ± 0.07 in the cautery group and 7.30 ± 0.05 in the no cautery group (p=0.34). Base excess values were −3.8 ± 2.1 vs −3.4 ± 2.3 mmol/L (p=0.42), while bicarbonate levels were 21.2 ± 2.8 vs 21.5 ± 3.0 mmol/L (p=0.61). Lactate levels remained low in both groups (2.6 ± 0.9 vs 2.4 ± 0.8 mmol/L, p=0.29), and random glucose levels were adequate (76.8 ± 9.7 vs 78.3 ± 10.2 mg/dL, p=0.47).

Table 2: Neonatal Acid–Base, Metabolic and Physiological Laboratory Parameters (N = 100)

Parameter	Cautery (n=50) Mean ± SD	No Cautery (n=50) Mean ± SD	Overall Mean ± SD	p-value
Cord blood pH	7.29 ± 0.07	7.30 ± 0.05	7.30 ± 0.06	0.34
Base excess (mmol/L)	−3.8 ± 2.1	−3.4 ± 2.3	−3.6 ± 2.2	0.42
HCO_3^- (mmol/L)	21.2 ± 2.8	21.5 ± 3.0	21.4 ± 2.9	0.61
Lactate (mmol/L)	2.6 ± 0.9	2.4 ± 0.8	2.5 ± 0.8	0.29
Random glucose (mg/dL)	76.8 ± 9.7	78.3 ± 10.2	77.6 ± 10.0	0.47

Indications for LSCS were comparable between groups, with previous LSCS being the most common indication (64% vs 62%), followed by maternal request (22% vs 20%) and abnormal presentation (8% vs 10%). Other indications such as failed induction (4% vs 2%) and cephalopelvic disproportion (2% vs 6%) were infrequent. No neonate in either group had an Apgar score <7 at 1 or 5 minutes. Cord acidosis (pH <7.20) occurred in 6% of the cautery group and 2% of the no cautery group (p=0.30). Oxygen desaturation below 95% was observed in 6% vs 12% (p=0.29), and NICU admissions were low in both groups (6% vs 8%, p=0.70).

Table 3: Indications for LSCS and Categorical Neonatal Outcomes (N = 100)

Variable	Cautery n (%)	No Cautery n (%)	Total n (%)	p-value
Previous LSCS	32 (64%)	31 (62%)	63 (63%)	0.84
Maternal request	11 (22%)	10 (20%)	21 (21%)	0.81
Abnormal presentation	4 (8%)	5 (10%)	9 (9%)	0.73
Failed induction	2 (4%)	1 (2%)	3 (3%)	0.56
Cephalopelvic disproportion	1 (2%)	3 (6%)	4 (4%)	0.31
Apgar <7 at 1 min	0 (0%)	0 (0%)	0 (0%)	1.00
Apgar <7 at 5 min	0 (0%)	0 (0%)	0 (0%)	1.00
Cord pH <7.20	3 (6%)	1 (2%)	4 (4%)	0.30
SpO_2 <95%	3 (6%)	6 (12%)	9 (9%)	0.29
Temperature <36.5°C	0 (0%)	0 (0%)	0 (0%)	1.00
NICU admission	3 (6%)	4 (8%)	7 (7%)	0.70

DISCUSSION

This was a prospective randomized case-control study that was done in order to assess the impact of employing monopolar cautery during abdominal entry in elective caesarean delivery on immediate neonatal outcomes. The overriding issue behind this study was that electrosurgical energy used when dissecting the abdomen might have a negative effect on the foetus by affecting uterine entry, peripheral thermal effects, or utilization of uteroplacental perfusion. The monopolar current essentially travels through the body of the patient before exiting through the ground plate. According to the results of the current research, monopolar cautery failed to exhibit any clinically or statistically significant negative effect on the outcomes of the neonatal rates compared to the traditional scalpel method. The baseline maternal and obstetric factors were similar in both groups such as maternal age, gestational age of delivery, parity, and the birth weight. Indications of caesarean section were also equally divided with previous caesarean section being the most frequent among the two groups. Such comparability reduces confounding and enhances internal validity of the research study as the observed outcomes in the neonatal were related more with the abdominal entry method than maternal or foetal risk factors.[20]

Neonatal well-being in Apgar scores showed no significant difference in groups 1, 5 and 10 minutes after birth. Good adaptation to extrauterine life was achieved among all neonates who had satisfactory Apgar scores of more than 7. Such results indicate that the application of the monopolar cautery in the abdominal entry does not reduce the foetal oxygenation nor delays delivery to the point that it results in neonatal depression. Clinically, the maintenance of normal scores of Apgar is encouraging and validates the safety of the use of electrocautery during caesarean delivery.[21] On the same note, other physiological indicators, such as oxygen saturation and temperature had no difference, and were similar in between groups. The mean SpO 2 data were within normal limits of neonatal cohort and there were no clinically significant incidences of hypoxia or thermoregulatory unsteadiness. These findings suggest that perioperative stress as a consequence of monopolar cautery is non-existent, and the immediate cardiorespiratory adaption of the neonatal care is not impaired. The absence of any adverse effects was further confirmed by the umbilical cord blood pH analysis which is an objective measure of foetal acid-base status and intrapartum hypoxia. Means of cord pH were within the normal physical ranges with no statistical significance. Very few neonates had mild acidosis, and this was not linked to the use of cautery. These results indicate that there is no effect of monopolar cautery on the uteroplacental perfusion and foetal metabolic conditions in cases of abdominal entry. The theoretical issues about electrocautery are based on the fact that they may cause thermal tissue damage, surgical smoke or long incision, which may indirectly affect foetal oxygenation. The current results, however, show that such anxieties might be very speculative as far as elective caesarean sections are concerned. As a matter of fact, the benefits of electrocautery include the possibility to reduce bleeding and have better surgical views which can help operate the abdominal cavity more easily and quickly. The incision-delivery time might be shorter which in theory could positively affect neonatal outcomes instead of having adverse effects.[22] These findings are aligned with other studies that have also proven that electrocautery is related to less operative time, less blood loss, and minimum postoperative morbidity that is not accompanied by a rise in complications. Previous research has cited that, monopolar cautery can lead to temporary and reversible physiological alterations in tissues but does not induce serious injuries to foetuses. Our results are in line with these findings and they present additional evidence to the safety profile of monopolar cautery in obstetric surgery. Practically speaking, the implications that these findings have on the clinical practice are significant. Monopolar cautery is common and regularly used in most surgical facilities. By proving its safety in neonatal care, the surgeons can use the technique without any fear of jeopardizing the outcomes of the foetus. This can help achieve increased efficiency in surgeries, decrease in operative time and enhanced haemostasis without compromising neonatal safety. However, some constraints must be mentioned. The research was also performed in one centre and the sample size is relatively moderate and this can be a limitation of generalization. Also, immediate neonatal outcomes were measured only; the long-term neonatal outcomes were not measured. These findings can be more substantiated by larger multicentre studies with prolonged follow-ups and more outcomes of interest including the duration of operations and maternal morbidity can be analyzed.

CONCLUSION

It is concluded that the use of monopolar cautery during abdominal entry in elective caesarean sections does not adversely affect immediate neonatal outcomes when compared with the conventional scalpel technique. Neonatal parameters including Apgar scores at 1, 5, and 10 minutes, oxygen saturation, temperature, and umbilical cord blood pH were comparable between both groups, with no statistically or clinically significant differences observed. No increase in neonatal depression, acidosis, or early complications was associated with cautery use.

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