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Original Article

Obstetrics and Gynaecology Section

Risk Factors Associated with Major Neonatal Birth Injuries During Caesarean Section in a Tertiary Care Hospital in Southern India

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ABSTRACT

Introduction: Neonatal birth injuries are commonly associated with instrumental vaginal deliveries, but have also been known to occur at uncomplicated vaginal or caesarean deliveries. Caesarean section confers some amount of protection against injuries at birth, but these can still occur with an incidence of 1.1%. Most common injury noted has been scalp lacerations followed by cephalohaematoma; others are fractures, brachial plexus injury, etc.

Aim: This study was carried out to find the incidence of and risk factors associated with major neonatal injuries sustained during Lower Segment Caesarean Section (LSCS) done in the Department of Obstetrics and Gynecology, Christian Medical College, Vellore, a tertiary level hospital in Southern India, over a period of one year.

Materials and Methods: The hospital numbers of babies who had sustained major birth injuries during LSCS from June 1st 2015 to May 31st 2016 were retrieved from the sentinel events register, being maintained by the charge nurse in the operation theatre. The details of the mothers, including details of LSCS, intraoperative findings, and their babies were then retrieved from the medical records.

Major birth injuries were defined as lacerations or cuts requiring suturing; fracture of bones; intracranial haemorrhage; skull fracture, facial nerve injury and intra-abdominal injury. The data was entered into clinical proforma and analysed using SPSS software (IBM, version 23). Descriptive measures like mean, median and standard deviation were computed for all continuous variables.

Results: There were a total of 12,430 deliveries in the period from June 1st 2015 to May 31st 2016, out of which 35% (4,375) were caesarean deliveries. Out of 4,375 caesarean deliveries, there were six cases of major neonatal birth injuries, incidence being 0.13%. Of the six birth injuries, 66.6% were lacerations and remaining were femoral fractures (33.3%).

We found that primiparous women carrying singleton pregnancies in cephalic presentation, undergoing LSCS following onset of labour were at increased risk of having major neonatal birth injuries. Presence of oligohydramnios intraoperatively, incision to delivery interval <5 minutes and surgery carried out by surgeons with mid-level expertise during "risk hours" (12am-8am) were also at risk. We did not find an increased risk with J or U shaped uterotomy incisions. Neonatal risk factors included prematurity and female gender. We did not find any correlation with very low birth weight and/or macrosomia. The average birth weight in this cohort was 2.35 kg.

Conclusion: Presence of risk factors like foetal prematurity, presence of oligohydramnios intraoperatively; incision to delivery interval <5 minutes and delivery during the "risk hours" increases the risk of major birth trauma at LSCS. However, our numbers are small to measure the exact correlation. Hence, prospective studies with larger sample size are needed to study the risk factors.

Keywords: Birth trauma, Childbirth, Lower segment caesarean section

INTRODUCTION

Injury to the baby during birth can occur during any delivery. Although they are more commonly encountered in vaginal deliveries requiring use of instruments such as forceps or suction cup, birth injuries may be encountered in otherwise uncomplicated vaginal or caesarean delivery [1]. The overall incidence of birth injuries is about 20 to 26 per 1000 deliveries, as seen in three population studies that included more than 8 million term infants [1-3]. A study from West Bengal, India found an incidence of 15.4/1000 births, 31.5% of which delivered by LSCS [4]. Alexander JM et al., found that the incidence of fetal injuries at LSCS was 1.1% [5].

Studies have found that caesarean delivery was protective for certain kinds of minor and major fetal trauma such as clavicular fracture and brachial plexus injury [1,3]. With caesarean delivery, the most common injury is scalp lacerations, followed by the occurrence of cephalohaematomas [5].

While there are a fair number of studies from the developed world which have looked at neonatal injuries only at LSCS [5,6], there are few from the Indian subcontinent doing so. From an Indian perspective, Ray S et al., found delivery in the early hours, nulliparity, prolonged labour to be significantly associated with injuries at birth [4]. Prabhu RS et al., found that nulliparity, malpresentation, obstructed labour were significantly associated with birth injuries, but the authors did not distinguish between mode of delivery [7].

Almost all the studies from the developing world look at composite birth injuries sustained both at vaginal delivery and LSCS [3,7-11]. With the rising number of caesarean deliveries in India, it is prudent to know the risk of injury to the infant at caesarean birth. We seek to identify any perinatal factors that may increase the risk of such injury, so as to anticipate and possibly prevent these injuries in the future.

Thus, the aim of the study was to find out incidence and risk factors associated with major neonatal injuries that were sustained during caesarean section in our hospital over one year period.

MATERIALS AND METHODS

A retrospective review of birth injuries that had occurred during caesarean section over a period of one year was conducted.

Sentinel events register was searched for neonatal birth injuries sustained at LSCS from June 1st 2015- May 31st 2016. The register is maintained by the charge nurse in the operation theatre. A total of six cases were found, and these charts were retrieved.

Maternal characteristics and details of LSCS, including indication and intraoperative findings were obtained from the medical records of pregnant women. Neonatal characteristics such as gestational age, gender, birth weight, type of injury, diagnosis and treatment given were retrieved from neonatal records. As per hospital protocol, all babies were examined by a neonatologist at birth. Based on the type of injury sustained, relevant speciality consultation was obtained. Presence of fractures was confirmed on radiographs. Suturing of lacerations was carried out in all cases by paediatric surgeons.

For the study, data from the medical records was entered into clinical proforma and analysed using SPSS software (IBM, version 23). The retrospective study was approved by Institutional Review Board and Ethics Committee of Christian Medical College and Hospital: IRB, Min No: 10922(Retro) dated 25.10.2017.

RESULTS

Of the total 4375 Caesarean deliveries over a one year period, from June 1, 2015 to May 31, 2016, there were six cases of major neonatal birth injuries, incidence being 0.13%. Four babies (66.6%) had lacerations that required suturing. The sites of injury were scalp, left hemithorax, abdominal wall and right ear. These sites coincided with the incision site on uterus in all cases. Two babies had fracture of femur.

Maternal Characteristics

Parity and Gestational age: Four (66.6%) of the pregnant women were primigravidas and two (33.3%) were multigravidas [Table/Fig-1]. Half of these pregnancies were preterm and the rest were term. Of the preterm pregnancies, two were late preterm at 36 weeks, while one was at 32+4 weeks.

Maternal Body Mass Index (BMI): According to World Health Organisation (WHO) classification of obesity, three patients had a normal BMI, two were overweight and one had class II obesity [Table/Fig-1]. The latter's baby suffered from a fracture of the femur.

LSCS Characteristics

Lie/Presentation and Technique of Delivery: Four babies (66.6%) were in cephalic presentation, one baby (16.6%) was breech and one (16.6%) in transverse lie [Table/Fig-1]. Of the four babies in cephalic presentation, three were delivered as cephalic and suffered scalp lacerations requiring suturing. One baby, although in cephalic presentation, had a deeply impacted head at delivery , therefore had to be delivered by reverse breech technique and sustained femoral fracture. Another baby in breech presentation had a laceration on trunk at the time of delivery. Yet another baby with prematurity and in transverse lie was delivered as breech and had a femoral fracture. This baby weighed only 960 grams at birth.

Indications for LSCS: One LSCS (16.6%) was posted as category I – done for doubtful scar integrity in a patient with previous LSCS. Two LSCS (33.3%) were done for non-reassuring foetal status as category II. The remaining LSCS (50%) were posted as category III [Table/Fig-1]. The indications for doing Category III Caesarean were: failed induction, foetal growth restriction with abnormal umbilical artery Doppler and breech in labour. All LSCS were done in labouring women and urgency of doing LSCS was based on modified Lucas Classification [11].

Stage of labour/ Trial of vaginal instrumental delivery prior to LSCS: Two patients had LSCS in the second stage of labour after full dilatation of cervix. One had fetal distress; the other was done for breech in labour. Neither of the two patients in second stage had a trial of vaginal instrumental delivery. Four women had LSCS in the first stage of labour [Table/Fig-1].

Intraoperative Factors: Three intraoperative risk factors were associated with neonatal birth injuries. The presence of intra-abdominal adhesions due to previous surgeries: like LSCS or myomectomy; lack of amniotic fluid; which influences the ease of delivery and the presence of the fibroids distorting the uterine anatomy. One patient had a previous LSCS as well as a previous myomectomy with dense intra-abdominal adhesions, making surgery technically difficult. Another patient had a large 6x7 cm lateral intramural fibroid, along with many other seedling fibroids. Four patients (66.6%) had scanty amniotic fluid at delivery [Table/Fig-1].

Risk Factors	Numbers (n)	Percentage of total cases (N=6) %
Maternal		
a. Parity		
-Primi	4	66.6
-Multi	2	33.3
b. Gestational age		
Preterm <37 weeks	3	50
Term >37 weeks	3	50
c. Maternal BMI		
< 40kg/m^2	6	100
> 40kg/m^2	0	0
d. Stage of labour		
Early	4	66.6
Active	2	33.3
LSCS		
a. Type of incision		
Kerr's	5	83.3
J/ T shaped	1	16.6
b. Intraoperative findings		
Adhesions	1	16.6
Fibroid	1	16.6
Oligohydramnios	4	66.6
c. Category of LSCS		
Category I	1	16.6
Category II	2	33.3
Category III	3	50
d. Incision to delivery		
<5 minutes	6	100
>5 minutes	0	0
e. Expertise of surgeon		
Level 1	0	0
Level 2	6	100
Level 3	0	0
Neonatal		
a. Presentation		
Vertex	4	66.6
Non-vertex	2	33.3
b. Gender		
Male	2	33.3
Female	4	66.6
c. Birthweight (grams)		
<1500	2	33.3
1501-2000	1	16.6
2001-3500	2	33.3
3501-4000	1	16.6

[Table/Fig-1]: Risk factors associated with major birth injuries at LSCS.

Type of Uterine Incision: We conventionally use the Kerr's incision, low transverse incision to deliver the foetus. Out of six cases, one patient needed J shaped incision, while others were delivered by Kerr's incision [Table/Fig-1]. Another patient undergoing LSCS at 32+4 weeks had dense adhesions from previous LSCS, obscuring the lower segment. Hence transverse incision was made in the upper segment.

Incision to Delivery Interval: The incision to delivery interval in all six cases was less than five minutes [Table/Fig-1]. Two babies were delivered within two minutes. Even though nearly half the LSCS were done as Category III, the workload of managing a busy labour room prompted the surgeons to be quick in delivering the babies.

Expertise of Surgeon: The expertise of surgeons was classified into three levels based on their years of experience: Level 1: Post graduates in their first or second year of training, Level 2: Senior Residents who are diploma holders in Obstetrics and Gynaecology who have minimum three years' experience and Level 3: Junior

Consultants who had completed their Diploma as well as Masters in Obstetrics and Gynaecology and had minimum of four years' experience.

All the cases in this cohort were performed by Level 2 Surgeons and were assisted by either interns or house surgeons [Table/Fig-1]. The obstetricians performing the LSCS were also in charge of managing the labour room.

Timing of LSCS: Most of the LSCS were performed by the doctors posted in the labour ward ,and were also responsible for managing the labour ward. Five out of six LSCS (83.33%) were carried out between 12 midnight and 8 am.

Neonatal Characteristics

Half of the babies having major trauma were preterm <37 weeks gestational age at birth. None of the babies in our cohort were either very low birth weight or macrosomic. The mean birth weight was 2.35 Kg ranging from 0.9 kg to 3.56 Kg. Four babies (66.66%) were females and rest were male [Table/Fig-1].

DISCUSSION

Caesarean section is the most common surgical procedure performed in obstetrics. There has been an escalation in the rates of LSCS globally in the last few decades. There are known risks to both mother and her baby during LSCS. Although a number of studies examine maternal safety associated with LSCS, there are very few studies that address the neonatal safety [3].

Birth injuries are defined by the National Vital Statistics report as "an impairment to infant's body structure or function due to adverse influences that occurred at birth" [12]. In the United States, the incidence of birth trauma varies from 0.2 to 37 per 1000 live births [13]. Studies done in India from tertiary care centres, having similar setup as ours have found an overall incidence of birth trauma ranging from 3.2 to 15.4 /1000 live births [7,9].

During the period of June 1st 2015 to May 31st 2016, the incidence of major neonatal birth injuries at caesarean sections in our hospital was 0.13%. Baskett TF et al., found that the incidence of major birth trauma at caesarean delivery was low (0.04% vs 0.02% with and without labour) [1]. Alexander JM et al., however, found an incidence of 1.1% [5].

Only one study has described the type of birth injury in relation to the mode of delivery. These authors found that injuries like fracture of clavicle; injury to brachial plexus; cephalohaematoma, and caput succedaneum were all much lower among babies born by LSCS in comparison to those born by vaginal delivery. Injuries like lacerations, sub-galeal bleed; subdural or intracerebral haemorrhage; injuries to skeleton and facial nerve injuries, on the other hand, were similar in both the groups [3].

The most common birth injury noted in our cohort was lacerations (four patients, 66.6%), with an incidence of 0.0009% [Table/Fig-2]. Alexander JM et al., found an incidence of lacerations of 0.7% [5]. The lower incidence of lacerations noted in our cohort could be explained by the fact that we took into consideration only those lacerations which required suturing. Femoral fractures occurred in two patients, 33.3%, with an incidence of 0.0004% livebirths. This is similar to studies done by Morris S et al., and Basha A et al., where the incidence was 0.17/1000 livebirths and 0.13/1000 livebirths respectively [14,15].

Factors predisposing to neonatal birth trauma, traditionally described in medical literature include: primigravida mothers; maternal obesity (body mass index >40 kg/m^2); cephalopelvic disproportion; small maternal stature; maternal pelvic abnormalities; prolonged labour; fetal malpresentation; operative vaginal delivery (suction cup/forceps); very low birth weight or extreme prematurity and fetal macrosomia [16-18]. However, most of these risk factors have been implicated in neonatal injuries following delivery via vaginal route. None of the studies have looked at perinatal risk factors associated with birth injuries specifically in relation to LSCS. This makes our study unique since we have tried to identify risk factors for birth injuries specific to LSCS. The presence of large uterine fibroids, intraoperative adhesions and oligohydramnios are factors that could lead to intraoperative difficulty and contribute to the occurrence of fetal birth injuries during LSCS.

All of the six patients in our cohort, whose babies sustained major birth injury, were in labour when posted for LSCS. Similar observations were made by Baskett TF et al., who found that women in labour, at the time of LSCS, had greater chances of having major and minor neonatal birth injuries in comparison to those not in labour [1]. Alexander JM et al., also found that the incidence of neonatal birth injuries was very low when LSCS was done prior to onset of labour [5]. Moreover, they also found that women undergoing trial of instrumental delivery prior to LSCS, had almost 7% incidence of birth injuries [5]. In our study, however, there was no history of failed instrumentation prior to caesarean section [Table/Fig-2].

In our study, the incision to delivery interval in all cases were <5 minutes. This observation is similar to the findings by Alexander JM et al., who found a higher incidence of birth injuries in association with an incision to delivery interval of <3 minutes [Table/Fig-2] [1,4,5]. Although most of the cases were Category III LSCS, which did not warrant emergent delivery, the clinical workload of managing a busy labour room prompted the surgeons to hasten the delivery of babies.

Outcome or subgroup title	Pinto Rosario et al., South India 2018	Baskett TF et al., Washington, USA [1]	Alexander JM et al., Texas, USA [5]	Ray S et al., East India [4]
Maternal				
-Parity	Nulliparity	Nulliparity (p<0.001)	-	Nulliparity
-Gestational age	-	Not studied	-	-
-Maternal BMI	-	-	-	-
-Stage of labour	Early labour	Labour not associated	-	Prolonged labour (p<0.001)
LSCS				
-Type of incision	Kerrs	-	T/J incision	-
-Intraop findings	Adhesions, fibroids, oligohydramnios	-	-	-
-Incision to delivery interval	< 5min	-	<3 min	-
-Expertise of surgeon	Level 2	-	-	-
-Failed instrumentation	-	Higher risk	Higher risk	-
Time of Delivery	12-8 am			2am to 8am (p<0.001)
Neonatal				
-Most common injury	Lacerations	Brachial plexus injury, Cephalohaematoma (not specific to LSCS)	Lacerations	Soft tissue injury
-Presentation	Vertex	-	-	Vertex (p<0.001)
-Gender	Female	-	-	Female
-Birthweight	-	-	-	Higher birthweight

[Table/Fig-2]: Comparison of birth injuries at LSCS between studies [1,4,5].

In contrast to findings by Alexander JM et al., who found higher incidence of birth injuries when T or J shaped incisions were used in comparison to vertical and low transverse incision, we had majority of birth injuries with low transverse Kerr's incision [5]. Only two patients in our cohort received T or J shaped uterotomy incision. Presence of oligohydramnios intraoperatively also seemed to increase the risk for neonatal birth trauma [Table/Fig-2].

Delivery of baby as breech, especially in association with factors such as transverse lie of the fetus, prematurity and deeply impacted head during second stage caesarean, was found to be associated with femoral fracture. Basha A et al., also found that emergency caesarean, prematurity, malpresentation, abnormal lie and multiple

pregnancies carried a risk of long bone fractures [15]. Alexander JM et al, however, did not find an association between prematurity and neonatal injury [Table/Fig-2] [5].

BMI of the mother in our cohort did not seem to play a role, a finding consistent with other studies [5]. However, many studies have found maternal BMI> 40 kg/m^2 as a risk for neonatal birth trauma [17,19]. None of the women in our cohort had a BMI>40 kg/m^2.

All the operations in our cohort were performed by surgeons with mid-level expertise, this is in contrast to the study by Baskett TF et al., where all deliveries studied were attended to by senior obstetricians [Table/Fig-2] [1].

Most of the cases of birth injuries were encountered in cases of LSCS done outside the routine hours, between 12 midnight to 8 am. (n=5; 83.3%). This is similar to the findings by Ray S et al., who found that the delivery between 2:00 am to 8:00 am, carried a higher risk of birth injury [Table/Fig-2] [4]. This could be attributed to fatigue of surgical staff leading to errors.

Foetal macrosomia (birth weight >4kg) has been found to increase the risk of birth injuries. In one study, the risk of birth injuries was found to increase two fold in infants weighing 4000-4499 g and threefold in those weighing 4500-4999 g in comparison to their normosomic counterparts [19]. In another study, the incidence of foetal injuries was 7.7 percent in infants with birth weights greater than 4500 g [17]. However, none of the babies in our cohort were macrosomic.

Majority of the babies in our cohort were females. This is in contrast to observations by Warke C et al., who found a male preponderance in their study [9]. Another study from India also found a stronger association of birth injuries with female gender of infants than male [Table/Fig-2] [4].

LIMITATION

The main drawback of our study is that we could not measure the exact correlation of these risk factors with birth injuries due to the small numbers.

CONCLUSION

Risk of major neonatal birth injuries was increased when LSCS was done on labouring women especially between 12 midnight to 8am by obstetricians with mid-level expertise. Maternal risk factors that seemed to play a role included primiparity, presence of intraoperative adhesions or fibroids and oligohydramnios. Incision to delivery interval <5minutes also seems to increase the risk. Fetal risk factors that could play a role include prematurity and female gender.

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