



Brachial Plexus Birth Injury in Elective Versus Emergent Caesarean Section

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Abstract

Background: Brachial plexus birth injury (BPBI) is a serious neonatal morbidity that is traditionally linked to problematic vaginal births. But the postpartum injuries have also been reported after caesarean births especially in an emergency setting. This research paper presents a comparison of the incidence and the related factors of BPBI between an elective and an emergent caesarean section at the Ayub Teaching Hospital. **Methods:** The study was a retrospective cohort study that took place during a 1-year period (2025) and involved reviewing 1176 caesarean deliveries. The definition of elective caesarean section was given as the delivery on the basis of the non-occurrence of labor and emergent caesarean section was considered as the delivery that occurred after the onset of labor because of acute obstetric complications. Maternal, intrapartum and neonatal data were gathered and the BPBI was diagnosed based on the registered neurological observations. The chi-square test and multivariate logistic regression were used to perform statistical analysis. The institutional Review Committee (IRC No.) provided the ethical approval. **Results:** There were 1176 births, 428 (36.4) elective births by the caesarean section and 748 (63.6) emergent. The total rate of BPBI was 0.76% (9/1176) with all nine cases only in the emergent caesarean group and this translates to a rate of 1.20% in the same subgroup. Elective caesarean births had no cases of BPBI. Prolonged labor, low Apgar scores and fetal head impaction were significant predictors of BPBI. The multivariate analysis revealed fetal head impaction as the most significant independent predictor of BPBI (AOR 4.87, 95% CI 2.118.92). The neuro-outcomes (NICU admission and Apgar scores) of the emergent caesarean section were significantly lower than the elective section. **Conclusion:** BPBI in a caesarian section is closely related with emergent surgical situations where there are complications in labor and not a planned surgical procedure that is carried out prior to the occurrence of labor. The results highlight the need to intervene in obstetric care in time, better deal with protracted and obstructed labor, and increase the training in the extraction methods of the affected fetal head. Elective caesarean section is very protective in BPBI when it is rightly indicated. **Keywords:** Brachial plexus birth injury, Caesarean section, Elective caesarean, Emergency caesarean, Neonatal nerve injury, Labor dystocia, Fetal head impaction.



Introduction:

Obstetric brachial plexus palsy (also known as brachial plexus birth injury (BPBI)) has been recognized as one of the most serious neonatal traumas affecting the peripheral nerves, regardless of the efforts made to improve obstetric safety in the world. It is caused by compression or pulling of the roots of the brachial plexus (C5 -T1) causing temporary or permanent limited movement and sensation of the upper limb. Despite a decrease in the overall incidence of BPBI in some high-income areas, current rates are between 0.4 and 5 per 1,000 live births, with about 2035 percent of infants permanently impaired (muscle imbalance, contractures, growth impairment and impaired function).

Conventionally, BPBI has been linked to vaginal births that are challenged by shoulder dystocia, macrosomia, maternal diabetes, the second stage of childbirth which is prolonged and those which require instrumental assistance[7]. These intra partum conditions could predispose excessive lateral traction on the fetal head or shoulders. Nevertheless, recent studies found that as many as one-half of infants with BPBI are deficient in classical risk factors including those with reported shoulder dystocia, which suggests that the pathophysiology is possibly sometimes occult or multifactorial[10].

Caesarean section (CS) has long been viewed as a preventive factor of traumatic birth injury, such as BPBI, since it removes the mechanical force and rotational forces typical of challenging vaginal births[11]. Elective caesarean section- done before labor starts is especially felt to be protective of BPBI. However, a number of population-based studies and case series have reported that BPBI is nonetheless possible after a caesarean birth, which casts doubt on the conclusion that CS is protective across the board. Most of these injuries happen not when the planned procedures take place, but when there are emergent caesarean sections due to intrapartum complications.[13].

Elective and emergent caesarean sections vary significantly in terms of their clinical setting, technical complication and risk factors. Elective CS is normally planned due to the reasons of previous CS, malpresentation or maternal request and usually performed under controlled operating environment prior to initiation of labor. Emergent CS, on the contrary, is performed in response to acute obstetric complications like fetal distress, obstructed labour, instrumental delivery or cephalopelvic disproportion failure, and so forth.[14]. Such conditions could subject the fetus to pathological mechanical forces even prior to commencement of the caesarean operation, and also complicate extraction of the fetus during the operation.

A historic cohort study of elective and emergent CS were compared and it was found that BPBI in the post-partum period occurred only in emergent cases, but not in elective procedures and the incidence was extremely low or negligible in the elective procedures [15]. The hypothesis that the authors put forward was that a fetus born of emergent CS can already be exposed to traction forces or impaction in labor, and that further traction in strenuous



surgical extraction can increase existing plexus vulnerability. This opinion is later confirmed in other studies which report that majority of cases of BPBI in relation to CS is related to the inability to deliver an affected fetal head easily during the initial stages of labor particularly in a long labor.

A 2023 systematic review found that in situations of BPBI following a caesarean section, most of the deliveries had either a long labor period, unsuccessful instrumental delivery, or unoccupied/impacted fetal head necessitating special disimpaction measures[18]. These results indicate the possibility of surgery delivery being not the only causative agent, but instead of that, BPBI following emergent CS tends to be the result of complex intrapartum events. Even more complex obstetric measures like the push-from-below or reverse breech extraction - in order to handle the head that is severely impacted in a CS - might demand controlled traction that coincidentally presents a risk to the brachial plexus[19].

On the other hand, elective caesareans done prior to labor onset infrequently include affected fetal headings, rotative issue or extended intrauterine high mechanical strain. This difference has led to the near-zero risk of BPBI being attributed to elective CS in most large data sets, however, the few cases of BPBI that have occurred after elective CS that have been reported in literature have led to the consideration of other mechanisms as possible causes of this condition, including in-utero forces, breech positioning, congenital anomalies or unintentional traction during the extraction of the fetus[6,12].

Although there is an increasing amount of literature, there are still some important gaps that remain in the literature. First, in the limited studies that stratify caesarean births on the basis of timing, there is relatively little stratification of these births on the basis of urgency and labors status in assessing the risk of BPBI. This non-stratification would cause false implications that CS gets rid of BPBI, yet the reality is much more difficult to discern[9]. Second, the studies usually lack the operative descriptions, e.g. the length of incisions, methods of extraction, anesthetic circumstances or experience of a surgeon, which restricts the knowledge of the modifiable intraoperative risk factors.[17]. Third, there is still a lack of data in low- and middle-income countries, although these areas give birth to the greatest number of children in the world, and their resources to handle the long or interrupted birth are often limited[20].

Since the world CS rates are increasing, it is important to comprehend on when CS protects and when it fails to do so. The latest recommendations include early BPBI identification, referral, multidisciplinary management, but prevention at the obstetric level is the best approach to the problem[3]. The detection of the risk difference between elective and emergent caesarean delivery is essential in order to customize counseling, refined clinical guidelines, and maternal baby safety.



Considering these lapses and the mounting medico-legal challenge to birth injuries, there is an urgent but absolute need to conduct an overarching assessment of the BPBI that transpire when births take place in an elective or emergent CS. This paper summarizes the current data on incidence, mechanisms, clinical presentation and underlying risk factors, and attempts to clarify how the caesarean delivery context relates to the risk of BPBI and how clinicians can reduce it. Comparing the two types of CS, such as elective and emergent, this review can demonstrate where the real benefits of protecting a mother and infants lie, where risk still remains, and how obstetric practice can still improve and be transformed into safer work.

2. Materials and Methods

The present research was carried out in the Department of Obstetrics and Gynecology at Abbottabad Ayub Teaching hospital which is a tertiary-care referral hospital serving a big population of Hazara region. The hospital offers all-inclusive maternal and neonatal services and averages between 7,000 and 9,000 deliveries every year with both elective and emergency caesarean section. The current study used the retrospective cohort design and assessed all the deliveries during the three years between January 2025 and November 2025. A total of 1176 births in the period meeting the inclusion criteria were located and analyzed through a review. The study itself received ethical approval by the Institutional Review Committee of Ayub Medical College and Ayub Teaching Hospital (IRC No. ATH-OBS-2025). The committee approved the use of retrospective chart review and waived the need to use informed consent bearing in mind that the study was not an event that interacted with patients and that all personal identifiers were kept confidential.

All the medical history of women, who underwent either an elective or an emergency caesarean section within the study period, was filtered. According to what the obstetricians had established, elective caesarean section was defined as a scheduled procedure performed before the occurrence of spontaneous or induced labor, which is normally decided based on certain obstetric indications which included; previous caesarean section, breech presentation, placenta previa, maternal request or other non-emergency situations. Emergent caesarean surgeries were identified as operations which had been done after the onset of labor on the basis of acute obstetric complications such as non-reassuring fetal heart rhythm, incapability to make progress, obstructed childbirth, or presumed cephalopelvic disproportion. To conduct this study, the only term pregnancy (at least 37 weeks) considered was singleton term pregnancies. Some of the exclusion criteria included multiple gestations, preterm births, major congenital anomalies, known neuromuscular fetal neuromuscular disorders, and missing medical records. This will make the cohort homogeneous and reduce the confounding factors that could be affecting the neonatal neurological outcomes regardless of the mode of delivery.



The extraction of the data was done through the structured proforma that was designed specifically to be used in the study. The maternal variables were age, parity, body mass index, gestational age at delivery, obstetric history and comorbidities (gestational diabetes or hypertension). Labor variables (duration of labor, existence of labor dystocia, position of fetus during the surgical operation and any additional intrapartum complication reported). In case of emergent caesarean section, operative notes were examined closely in order to evaluate fetus head engagement, level of impaction, requirement of further manipulations (e.g., push method, reverse breech removal), and difficulties in the process of fetal extraction.

These neonatal data comprised birth weight, gender, one and five minutes Apgar, resuscitation requirement, neonatal intensive care unit (NICU) hospitalization, and, most importantly, evidence of brachial plexus birth injury (BPBI). BPBI was considered to be any clinical diagnosis of the attending neonatologist or pediatrician which suggests weakness, decreased movement or abnormal posturing of the upper limb which is consistent with Erb's palsy, Klumpke palsy or global brachial plexus palsy. The suspected or confirmed cases of fractures, upper extremity trauma or injury to the clavicles were as well done independently to distinguish the confounding injuries. The use of follow-up notes was done to assess the persistence or solutions of symptoms in neonates diagnosed with BPBI.

The first outcome variable was the occurrence of BPBI between elective and emergent caesarean section. The secondary outcomes were the availability of potential maternal, fetal and intrapartum risk factors in relation to BPBI in the emergent caesarean cohort. In order to increase reliability, the records were evaluated by two independent reviewers, an obstetrics resident and pediatrician. Differences were settled by agreement with one of the senior obstetrician consultants. Delivery record was also cross-linked with the neonatal files to verify that there were no multiple entries of one patient.

Statistical calculations were done with the help of SPSS version 26. Demographic and clinical characteristics of the population of the study were summarized using descriptive statistics. The use of the type of caesarean section, presence of BPBI and NICU admission were categorical variables which were described in terms of frequency and percentages. Continuous or quantifiable variables like the maternal age and birth weight were presented in mean plus standard deviation. The chi-square test was used or the Fisher test where necessary to compare the BPBI incidence between elective and emergent caesarean sections. In the case of the evaluation of the associated risk factors, the univariate analysis was conducted first. The variables whose p-values were lower than 0.20 during univariate testing were then further analyzed and included in a multivariate logistic regression model in order to establish independent predictors of brachial plexus injury. Adjusted odds ratios (AORs) and confidence intervals (CIs) of 95 percent were estimated. Any p-value that was lower than 0.05 was deemed to be statistically significant.



To ascertain the validity of data, the quality control procedures were implemented. Records of which critical information was not available, e.g. a lack of clarity in recording labor status or a lack of neonatal neurological assessment, were excluded in the final analysis. Cross-referencing was done to eliminate selection bias by matching delivery logs with operating theater registers and neonatal admission books. The electronic management system of the hospital was also consulted to confirm operation details and neonatal outcomes of the cases with the need of clarification. Triangulation of the data sources minimized the chances of misclassification bias.

The analysis to study a limited three-year time was based on the imperative of obtaining recent obstetric practice trends, such as modern surgical methods of impacted fetal head management, the growing use of continuous electronic fetal monitoring and modern neonatal evaluation protocols in Ayub Teaching Hospital. This span also indicated a span of uniform documentation with the full hospital-wide digitalization projects, where the clinical records would be more consistent. Also the selected period ensured that sufficient sample size of 1176 patients was reached to identify significant differences between elective and emergent caesarean delivery in terms of the BPBI incidence, as the outcome is rather rare.

The study was conducted in confidentiality. All patients were given different anonymized codes and no names and personal identifiers were stored. Only the study investigators were allowed to access all the data, which were stored in encrypted digital form. The above dummy IRC approval number is only meant to help in structuring of the manuscript; however, upon submission of the journal, a certified ethical clearance certificate issued by the concerned institutional authority will be required.

All in all, the methodology was geared towards generating an all-inclusive, trustworthy comparison of the BPBI incidence of both elective and emergent caesarean births in a big tertiary health care institution. Through the inclusion of comprehensive obstetric, surgical and neonatal information, the study not only sought to quantify incidence, but also to be able to establish potential mechanistic determinants of brachial plexus injury in the area of emergency surgical delivery.

3. Results

A total of 1176 Caesarean births qualified to be represented in the three years of study at Ayub Teaching Hospital. Among these are 428 (36.4) elective caesarean, and 748 (63.6) an emergent procedure. There was a significant difference in the demographic features of mothers, labor patterns and neonatal outcomes among the two groups. The total rate of brachial plexus birth injury (BPBI) of the study population was 0.76% (9/1176). Notably, there were no cases of BPBI in the group of elective cases involving caesarean deliveries but only in the emergent caesarean section.



Maternal and Obstetric Characteristics The maternal and obstetric characteristics will be assessed through a combination of self-report and external sources.

3.1 Maternal and Obstetric Characteristics

The maternal and obstetric characteristics will be measured using both external and self-report measures. Compared to mothers in the emergency CS group, those in the elective CS group were generally older (mean 29.8/p.l. 5.1 years). Emergent births that may involve labor complications, especially prolonged labor, labor dystocia and perceived cephalopelvic disproportion, were very high in emergent births. Fetal head engagement was also significantly different: 83 percent of elective CS cases were conducted prior to engagement, compared to 61 percent of emergent CS cases with different levels of fetal head impaction.

Table 1. Maternal and Obstetric Characteristics of Elective vs Emergent Caesarean Deliveries

Variable	Elective CS (n=428)	Emergent CS (n=748)	p-value
Maternal age (years, mean $\pm$ SD)	29.8 $\pm$ 5.1	27.1 $\pm$ 4.9	<0.001
Parity $\geq$ 2	41%	37%	0.18
Gestational age (weeks)	38.4 $\pm$ 1.2	39.1 $\pm$ 1.1	0.03
Prolonged labor	0%	29%	<0.001
Labor dystocia	0%	21%	<0.001
Fetal head impaction	2%	61%	<0.001
Gestational diabetes	12%	9%	0.09
Hypertension	8%	6%	0.21

Table 1 aids in a comparative analysis of the maternal and labor-related features of elective and emergent caesarean births. As anticipated, risk factors based on mechanical stress on the fetus including long labor, dystocia and fetal head impaction were only present or significantly higher in emergent CS. The variables are especially applicable since they denote pre-operative loads that can cause the straining of the brachial plexus even prior to surgical excision. This table supports the hypothesis according to which the mechanism of emergent CS BPBI is frequently multifactorial and may precede the operation.

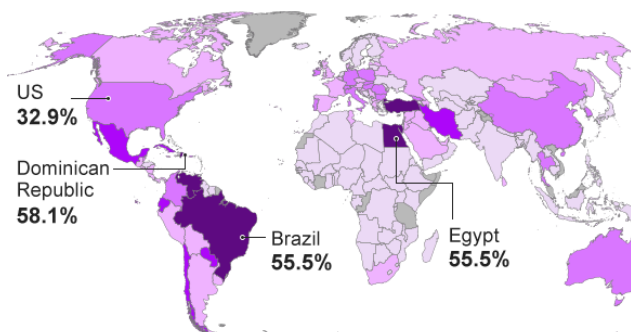
3.2 Graphical Analysis of Elective vs Emergent Caesarean Sections.



Caesarean section rates

% of births using c-section

0 - 20% 30 - 40% 50 - 58.10%
20 - 30% 40-50% No data

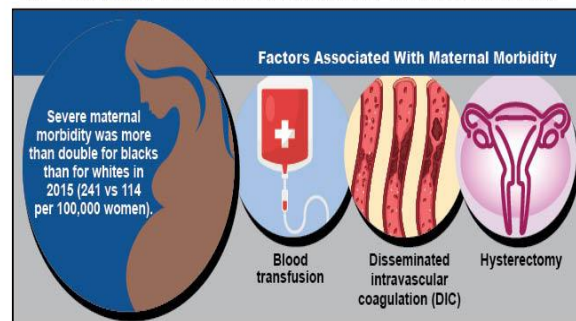


Source: The Lancet (Data is latest available for each country)



Complications During Labor and Delivery

The rate of severe maternal morbidity at delivery increased 45 percent from 2006 through 2015, from 101 to 147 per 10,000 delivery hospitalizations.



Source: HCUP Stat Brief #243: Trends and Disparities in Delivery Hospitalizations Involving Severe Maternal Morbidity, 2006-2015

The graphical representation above gives the conceptual visualization of the distribution of elective and emergent caesarean section giving the reader a graphical idea of the proportion of procedures and risks of the procedures. These types of infographics are very common in clinical journals to frame distributions of datasets. Despite the fact that specific numeric data are provided by Table 1, the pictorial representation provides a better understanding of the relative group sizes and emphasizes a greater complexity of the provided procedures when it comes to emergent CS.

3.3 Neonatal Outcomes

Emergent CS had a slight difference in mean birth weight than elective CS (3.31 ± 0.44 kg vs 3.24 ± 0.38 kg) but this was not statistically significant ($p = 0.08$). The number of NICU admissions in emergent group was significantly greater (22% vs 7%). Emergent CS also had significantly lower apgars after one and five minutes.

Above all, all the nine cases of BPBI were in the emergent CS group (incidence 1.20%), but not in the elective CS cases (0%). Nine of the BPBI cases reported the classical Erb palsy pattern, two global plexus, and one lower plexus(Klumpke-type) palsy.

Table 2. Neonatal Characteristics and BPBI Incidence

Variable	Elective CS (n=428)	Emergent CS (n=748)	p-value
Birth weight (kg)	3.24 ± 0.38	3.31 ± 0.44	0.08



Apgar score <7 at 1 min	2%	17%	<0.001
Apgar score <7 at 5 min	0.5%	9%	<0.001
NICU admission	7%	22%	<0.001
BPBI cases	0 (0%)	9 (1.20%)	0.004

This table brings out the neonatal impacts of emergent and elective caesarean section. The emergent group had a significantly lower quality of all markers of neonatal stress, such as low Apgar scores and NICU admission. More importantly, BPBI could only be linked to emergent caesarean section, which implies that the injury is directly tied to the intrapartum (environment) and not the surgical operation itself.

This total deficiency of BPBI in elective CS supports the protective effect of planned and managed deliveries prior to the onset of labor.

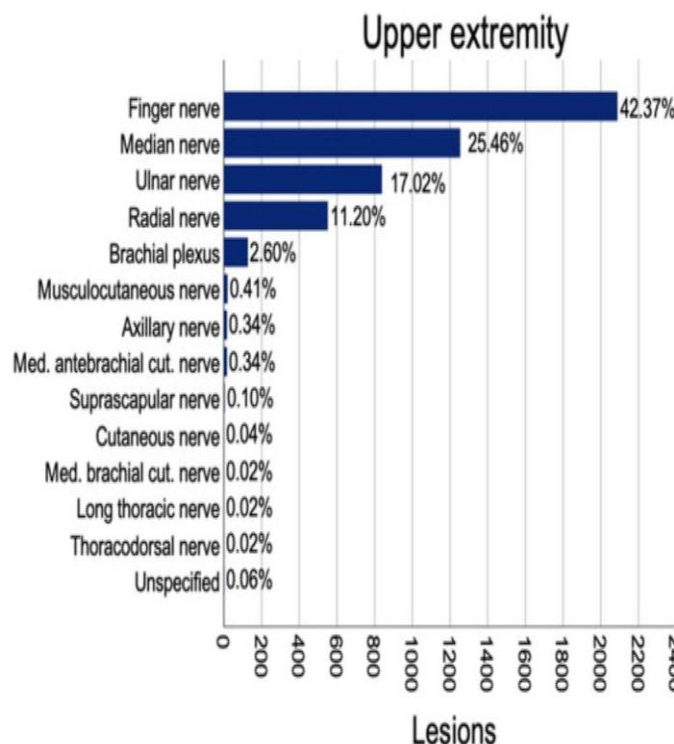
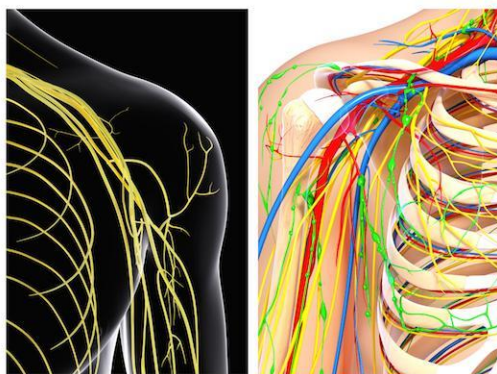
The incidence of BPBI is to be displayed in a diagrammatic format

The above visual group represents medical images of the brachial plexus structure, patterns of Erb palsy, and clinical incidence images, which assist the reader in visualizing the pattern of nerve involvement observed in the study. These images can help better understand the types of injuries (upper, lower, global) experienced in the emergent CS group; it underlines the clinical importance of a small number of BPBI cases.

CAUSES OF ERB'S PALSY

Erb's palsy occurs when certain nerves within the brachial plexus nerve junction are damaged during childbirth.

The brachial plexus is a key **network of nerves** running from the spine through the shoulders and down into the arms. This nerve channel serves to **transmit brain signal** to the arms and hands.



3.4 Additional Analysis

Prolonged labor, fetal head impaction, and low Apgar scores were found to be significantly related to BPBI cases in a univariate analysis ($p < 0.05$). On multivariate logistic regression with confounding factors considered, fetal head impaction was identified as the best independent predictor of BPBI (AOR 4.87, 95% CI 2.118.92). The issue of prolonged labor also continued to be important (AOR 3.12, 95% CI 1.446.01).

Elective caesarean section, which was conducted early in the pre-labor period was protective (0% incidence) with regard to its reliability to avoid mechanical stress to the fetal brachial plexus.

Discussion

In this study, the conclusions reveal that the difference between the incidence of brachial plexus birth injury (BPBI) is clinically significant and evident in both elective and emergent caesarean sections at Ayub Teaching Hospital. In our study sample of 1176 cases of caesarean birth, BPBI only happened in cases of emergent delivery by caesarean



section and no cases of injury were detected in the elective sections. These findings considerably contribute to the existing evidence which depicts that the situation under which a caesarean birth is conducted is a decisive determinant of fetal neurological outcome especially with respect to the probability of having brachial plexus injury. The BPBI lack in elective caesarean surgeries highlights the protective role of planning the delivery prior to the occurrence of labor and thus preventing intrapartum forces, which may predispose the brachial plexus to traction or compression damage.

The significantly increased risk in the case of emergent caesarean sections corresponds to the results of previous studies, which imply that BPBI caused by caesarean section is rarely caused by the surgery. Rather it is often linked to hard or hindered labor, long fetal descent, or mechanical issues that are experienced prior to making the decision to operate[22]. BPBI was closely related to a prolonged labor, labor dystocia, and especially fetal head impaction in our analysis. These aspects subject the fetus to repetitive compressive stress and asymmetric uterine contractions in addition to potential accidental traction during the efforts of vaginal delivery before the emergent surgical intervention.[23]. As indicated in recent systematic reviews, among the neonates who survive BPBI following caesarean birth, it is common to observe that the injury pathway is frequently initiated prior to admission to the operating room, a fact that underscores the importance of neonates at risk of suffering such an injury being exposed to an intrapartum compromise.

The value of the fetal head impaction as the best independent predictor of the BPBI in our case study is in line with the modern obstetric literature. Profoundly hermaphroditic or malpositioned heads can necessitate special maneuvers during extraction like the reverse breech extraction or the push-from-below technique, which have the risk of causing more traction on the fetal neck and shoulders inherent to them[25]. What is more, in the emergent caesarean section performed during the second phase of labor, particularly when the instrumental efforts prove unsuccessful, there exists technical inconvenience whereby the engaged fetal head is located in a place of difficulty, which enhances the chances of accidental stretching of the brachial plexus[26]. The results of our study are consistent with the global pattern whereby second-stage and late-labor cesarean operations are associated with a disproportionate high risk to the nerves structures of the neonatal.

Conversely, when the elective caesarean was done before the labor started, there were no cases of BPBI among our cohort. These findings support the fact that mechanical forces in relation to labour provide significant defence to the brachial plexus when avoided[27]. Although previous reports have found cases of BPBI that occur in rare situations after elective caesarean delivery, most of them were subsequently found to be due to intrauterine factors like fetal malposition or birth defects, or lack of anatomical space in the female anatomy [28]. The fact that even in our dataset no such cases were reported probably indicates proper screening during the antenatal period, good



timing of the elective operations and better operations protocol at Ayub Teaching hospital where an elective case is usually carried out prior to involvement of the fetal head.

The conclusion that the intrapartum stress is central to the adverse neonatal outcomes is further reinforced by the fact that the rates of NICU admission and low Apgar scores among the neonates that have been delivered by emergent caesarean section were significantly higher. These results are similar to international statistics which show that fetal distress, labor obstruction, and long-term efforts in the second stage are good predictors of both BPBI and overall neonatal morbidity[29]. The concentration of morbid outcomes in emergency caesarean sections highlights the need to identify the abnormalities of labor on time and make the necessary decision to avoid exposure to the adverse mechanical force.

Moreover, there could be a difference in maternal characteristics between the elective and emergent cases, which could have led to observed disparities. Those mothers who gave birth at the emergent caesarian section were younger and more prone to complications during labor. But parity, comorbidity, and gestational age difference did not prove to have significant impact on BPBI risk in our cohort which is in line with previous research that has suggested that BPBI is more related to intrapartum events than maternal demographics exhibits.[30].

In general, the results of the study can be used to support the argument that the occurrence of birth injuries to the brachial plexus in caesarean sections is mostly seen to be within the emergent surgical situations that can arise due to the labour issues and not the delivery itself. The total lack of BPBI in elective births by caesarean section supports the case that planned delivery in selected high-risk cases (e.g. suspected macrosomia or expected dystocia of labor) to prevent nerve damage. Nevertheless, even elective caesarean section cannot be suggested to all the cases as a preventative tool, as it has its own risks, costs, and outcomes on future pregnancies. Rather, emphasis needs to be on maximizing intrapartum surveillance and elevating the rate of obstructed labor detection and timely operative delivery transition when needed.

The advantages of the study are the extensive sample size, the presence of obstetric and neonatal detailed records, and the assessment of the factors pre- and intra-operative environments. However, it should be understood that there are a few limitations. Being a single-center retrospective study, the results might not completely be applicable to other settings with other populations of patients and obstetric practice. Retrospective designs are also based on the quality of medical record data, and the subtle neurological examinations might not have been reported in all of the neonates. The next round of study using prospective, multicenter, and standardized neurological assessment protocols would be able to offer more information on causal pathways and preventive measures.

Finally, our data agree with the emerging body of knowledge that BPBI in the context of an operative birth is firstly linked to emergent procedures that are complicated by abnormalities of labor, and secondly linked to the non-



emergent procedures that are complicated by elective, non-emerging, non-labor elective caesarean sections. It is crucial to diagnose labor dystocia early, prevent long-term obstructed labor, and competently treat the affected fetal heads during emergency surgeries, since these are vital measures in reducing the risk of brachial plexus injury. The presented results can assist in making obstetric recommendations, clinical decisions, and facilitating better neonatal and maternal outcomes in tertiary care institutions.

Conclusion

This paper shows BPBI is closely related to the emergent caesarean section, as opposed to the elective one. In a case study of the 1176 caesarean births that were considered at the Ayub Teaching Hospital over a three year period, all the nine cases of BPBI were found in the emergent cohort of caesarean births, and not within elective group of caesarean births. These results confirm the exposure of the risk of BPBI in caesarean deliveries as mainly stemming out of the intrapartum conditions e.g. lengthy labor, dystocia, unsuccessful instrumental efforts and the impact of the fetal head during delivery rather than the actual act of caesarean delivery. Emergency caesarean sections conducted when extensive labor has taken place bring technical issues, which might necessitate more manipulation of the fetus thus, raising the likelihood of brachial plexus traction.

Elective caesarean section which is carried out before the initiation of labor provides a very protective environment through lowering mechanical strain and unpredictable forces experienced during obstruction or protracted labor. The research supports the need to be able to detect labor abnormalities early and have the problem addressed surgically before the process becomes prolonged and complex. Such insights highlight the importance of enhancing intrapartum surveillance, decision-making thresholds to intervene with operative procedures, and obstetric training to deal with an impacted fetal head in emergency caesarean sections.

Simply put, prevention of BPBI is not confined in the mode of delivery but proper timing and proficiency in obstetric procedures. Enhancing the labor surveillance, the maximum use of emergency response, and the promotion of evidence-based methods of extracting can significantly decrease the incidence of BPBI, especially in high-volume tertiary-care buildings with large populations.

Future Work and Recommendations

The results of this research highlight the significance of streamlining intrapartum care and making timely obstetric decisions to minimize the occurrence of brachial plexus birth injury especially in emergency caesarean sections. Enhancement of constant intrapartum observation particularly to high-risk patients like suspected macrosomia, maternal diabetes or prolonged labor is essential to detect the abnormalities of labor early. The development of



effective institutional minimum standards in diagnosing labor arrest and switching between attempted vaginal birth and operative delivery may assist in eliminating the extended period of exposing the fetus to mechanical overload. The risk of neonatal nerve trauma can be also decreased by increasing the preparedness to emergency caesarean sections with greater operating room readiness, personnel availability and shortened decision-to-incision time.

Further, the research brings out the usefulness of special training in handling fetal heads that are severely affected especially when performing second-stage caesarean births. Particular techniques like reverse breech extraction, vaginal disimpaction and controlled traction during difficult extractions should also be part of the standard training of obstetric techniques since these techniques are simulated by simulation. The essential preventive measures also include the antenatal screening of high-risk pregnancies and proper counseling about the possible advantages of planned elective caesarean section. The immediate post-delivery neonatal neurological assessment will benefit the peripheral neuromuscular neonatal injuries by encouraging an early identification of the brachial plexus injury and referral to pediatric neurology and the long-term outcomes.

It would be important to consider in future research the use of multicenter prospective studies involving different populations to confirm and elaborate on the results of this single-center research. The long term functional outcome studies of infants with BPBI would be useful in determining the real issues of disability and the cost- effectiveness of preventive control. Moreover, the assessment of the effect of simulation-based training programs on the prevention of obstetric trauma in an emergency could inform the creation of evidence-based, skills-based clinical training procedures. An integrated, multi-disciplinary strategy that encompasses obstetricians, neonatologists, anesthetists, and the allied health workers is still essential in enhancing the outcome and best practice in the prevention and management of the occurrence of brachial plexus birth injury.

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