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| RESEARCH ARTICLE

Incidence of Trauma during Birth to Neonates Born to Mothers with Gestational Diabetes Mellitus

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| ABSTRACT

Gestational Diabetes Mellitus (GDM) is defined as glucose intolerance that occurs during pregnancy. The incidence of GDM has been on the rise and is a significant cause of various consequences for both the mother and infant. Such consequences include birth trauma. Factors such as shoulder dystocia and fetal macrosomia can increase the incidence of birth trauma. Additionally, GDM is a major cause of fetal macrosomia, influencing the intrapartum delivery method. This study aims to investigate the incidence of birth trauma in mothers with and without GDM. A total of 10,865 patients from King Hamad University Hospital (KHUH) were included, and their files were then further stratified only to include neonates with evidence of birth trauma. A total of 64 patients were found to fit the inclusion criteria. The study looked at GDM status, gestational age, birth weight, length, head circumference, mode of delivery, presentation of the baby before delivery, assistance during delivery, and maternal/neonatal trauma. Maternal trauma rates were found to be statistically significant within the population of the Kingdom of Bahrain. An increased incidence of maternal trauma was observed in the non-GDM group, with 56.3% of the patients requiring an episiotomy or having a complication of a vaginal laceration. Regarding the incidence of birth traumas in the GDM group, they presented most commonly with cephalohematoma or Erb's palsy, whereas the non-GDM group most commonly presented with cephalohematoma. The incidence of birth trauma due to GDM has seldom been researched in the existing literature. However, it has been noted that factors such as macrosomia can increase the likelihood of birth trauma. The general incidence of neonatal birth trauma has been reported to be 2.7%, which is reassuring; however, it is essential to investigate further the effect of GDM on the rates of birth trauma using large population cohorts.

| KEYWORDS

"Gestational Diabetes Mellitus," "Birth Trauma," "Maternal Trauma," "Cephalhematoma," "Erb's Palsy"

| ARTICLE INFORMATION

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1. Introduction

Gestational Diabetes Mellitus (GDM) is a commonly encountered pregnancy complication. It can be defined as glucose intolerance of varying severity, with the first onset seen during the 24th to 28th weeks of gestation. In modern times, as the incidence of obesity and Type II diabetes mellitus (DM) has dramatically increased worldwide, the incidence of GDM is on a rapid incline. It is well known that infants of diabetic mothers are liable to suffer various adverse consequences, including but not limited to respiratory distress, cardiac disorders, metabolic and hematologic disorders, neurologic impairment, and birth traumas. Macrosomia is the predominant adverse outcome and the main factor linked to neonatal complications (Al Mahroos, 2015). In a study conducted in the Kingdom of Bahrain, it was indicated that the incidence of GDM was found to be at the top of the recorded range globally (Al-Khaduri, 2014). Furthermore, it was found that within the population, first-degree relatives with diabetes were a factor in the high

prevalence of DM in the kingdom. Considering other factors, such as the increase in maternal weight, maternal age, and incidence of GDM, this implies a significant burden on health services within the kingdom.

Existing literature has mainly focused on the fetal complications arising as a result of Type I DM and Type II DM. However, minimal information is provided on birth trauma to neonates born to GDM mothers (Aloia, 2017). GDM is one of the most common complications of pregnancy in the Kingdom of Bahrain, with both short- and long-term effects on the mother and the fetus in terms of morbidity and mortality (Anwar, 2019). Such morbidities include shoulder dystocia and an increased risk of cesarean section that have been associated with GDM and fetal macrosomia (Behboudi-Gandevani, 2019). In a study conducted in the Sultanate of Oman, it was found that shoulder dystocia was more common in neonates with GDM mothers. In addition, vacuum and forceps deliveries were mainly associated with GDM labor due to the increased risk of macrosomia and failure of progress during labor. Erb's palsy was also the most prevalent complication associated with shoulder dystocia cases, with many of those cases having a large incidence of fetal morbidity and complications. Brachial nerve injuries and skeletal fractures were more likely to occur in infants of mothers with GDM or who had abnormally large babies in previous deliveries (Bener, 2011).

Another study conducted in the State of Qatar found an increased risk of birth trauma among the offspring of GDM mothers (Beta, 2019). With GDM being such a prevalent condition in the Gulf countries, it is crucial to have systemic and extensive research examining the significance of such cases and the burden it creates within the healthcare system of respective countries. Moreover, limited studies were conducted in the Kingdom of Bahrain on the incidence of neonatal trauma during delivery due to GDM. Therefore, it must be explored to improve and adapt neonatal management within the region.

1.1 Aim:

This study aims to identify the incidence of multiple traumatic complications during delivery that can be attributed to the fetal effects of GDM. The specific parameters examined include gestational age at birth, birth weight, head circumference, mode of delivery, any complications during delivery (such as the use of forceps and vacuum instruments), type of traumatic complication, and a consequence of traumatic complication, both maternal and fetal.

2. Methods

A sample of 10,865 neonates born in Bahrain was used from June 2013 to January 2020. The sample size is set in King Hamad University Hospital (KHUH), Kingdom of Bahrain. Inclusion and exclusion criteria were used to extract the targeted population. Out of 10,865 patients available for data collection, it was found that a total of 64 patients satisfied the inclusion criteria of the study.

The inclusion criteria for this study were as follows:

- Neonates born to mothers with and without Gestational Diabetes Mellitus at KHUH.
- Neonates born with documented evidence of defined birth traumas such as:
    - Cephalohematoma.
    - Subgalleal Hemorrhage.
    - Caput Succedaneum.
    - Brachial Plexus Injury (including Erb's Palsy and Klumpke's Paralysis).
    - Bone fractures.

The exclusion criteria for this study were as follows:

- Neonates who did not have documented evidence of birth trauma.

The following variables were applied to explore the data applicable to this study:

- GDM status of the patient's mother (GDM or Non-GDM).
- Gestational Age of the Patient (weeks).
- Birth weight (in grams) of the fetus.
- Length (in centimeters) of the fetus.
- Head circumference (in centimeters) of the fetus.
- Mode of delivery.
- Presentation of the fetus in utero.
- Assistance during delivery.
- Maternal Trauma.

- Neonatal Trauma.

3. Results

Once the data was collected, it was organized in a tabular form, separating the GDM and non-GDM groups. Furthermore, neonates were divided into males and females. The mean values of the abovementioned variables were obtained with a standard deviation. A p-value was calculated for each variable to ascertain the statistical significance of the values. A p-value less than 0.05 was considered statistically significant. Additionally, the Mann-Whitney p-value was obtained through statistical analysis to assess the statistical significance of the data. A p-value less than 0.05 was considered statistically significant.

Table 1: Comparison of Gestational Age, Birth Weight, and Head Circumference between Male and Female Neonates

GENDER			
Factors	Male	Female	Mann- Whitney p Value
Gestational Age (weeks)	39.42 ± 1.42	37.81 ± 3.51	0.268
Birth Weight (grams)	3324.7 ± 433.7	3179.5 ± 746.1	0.89
Head Circumference (cm)	34.79 ± 1.69	34.10 ± 1.28	0.58

- Demonstrates a comparison of gestational age, birth weight, and head circumference amongst male and female neonates. Although it was noted that the male neonates had a slightly increased birth weight and head circumference, there was no statistical difference in head circumference or birth weight between the two genders.

Table 2: Comparison of Gestational Age, Birth Weight, and Head Circumference of Neonates born to mothers with and without GDM.

GDM/Non-GDM			
	GDM (18)	Non-GDM (46)	Mann- Whitney p Value
Gestational Age (weeks)	38.77 ± 1.55	39.04 ± 2.35	0.304
Birth Weight (grams)	3159.2 ± 489.46	3277.4 ± 569.71	0.586
Head Circumference (cm)	34.08 ± 1.32	34.37 ± 1.58	0.901

- Compares the gestational age, birth weight, and head circumference in neonates born to mothers with and without GDM.
- Based on the data available from the hospital system, 5 of the 18 GDM mothers were managed with Glucophage (Metformin) and diet. In contrast, the remaining 13 patients' mothers were managed with diet only. It can be noted that patients in the GDM group had a slightly lower gestational age, birth weight, and head circumference.

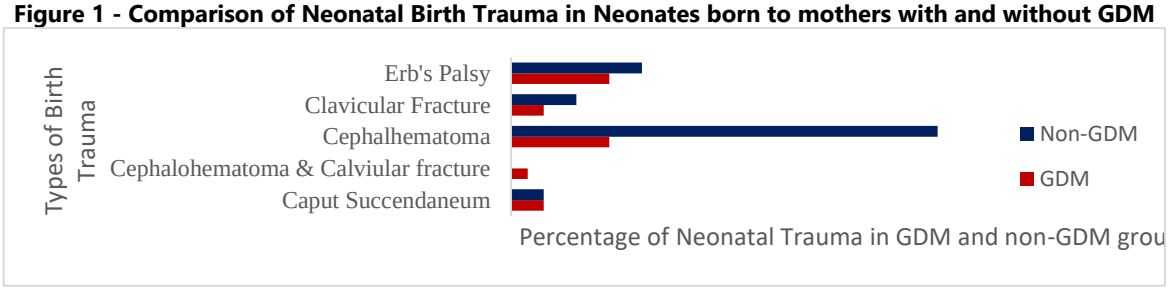
Table 3: Comparison of the Mode of Delivery, Presentation of the fetus, Assistance During Delivery, and Maternal and Neonatal Trauma amongst patients born to mothers with and without GDM

Factors	GDM	Non- GDM	Chi-square p
Mode of delivery			
Cesarean	2 (11.1%)	6 (13.0%)	0.60
Vaginal	16 (88.9%)	40 (87.05)	
Presentation of Baby			0.63
Breech	1 (5.6%)	2 (4.3%)	
Cephalic	17 (94.4%)	44 (95.7%)	
Assistance during Delivery			0.26
Yes	5 (27.8%)	15 (32.6%)	
No	12 (66.7%)	31 (67.4%)	
Maternal Trauma			
Bladder Rupture	0 (0%)	1 (1.6%)	0.037
Episiotomy	4 (6.3%)	20 (31.3%)	
First Degree Tear	5 (7.8%)	6 (9.4%)	
Lateral Vaginal Wall Tear	1 (1.6%)	0 (0%)	
Second-degree tear	1 (1.6%)	2 (3.1%)	
Vaginal Laceration	3 (4.7%)	0 (0%)	
Nil	4 (6.3%)	16 (25.0%)	

Neonatal Trauma			
Caput Succedaneum	2 (3.5%)	2 (3.5%)	0.186
Cephalhematoma	6 (10.5%)	26 (45.6%)	
Cephalohematoma & clavicular fracture	1 (1.8%)	0	
Clavicular Fracture	2 (3.5%)	4 (7.0%)	
Erb's Palsy	6 (10.5%)	8 (14.0%)	

- Compares the mode of delivery, presentation of the fetus, assistance during delivery, and maternal/neonatal trauma amongst neonates born to mothers with and without GDM. Regarding the mode of delivery and presentation of the fetus, most neonates were born via vaginal delivery in both groups with a cephalic presentation. The percentage of neonates requiring assistance during delivery was almost equal, with the GDM group having 66.7% of babies born through assistance during delivery and 67.4% in the non-GDM group.
- Maternal trauma was noted to be the only statistically significant set of results in this table, with a p-value of 0.037. The most common maternal trauma present in the GDM group was a first-degree tear, whereas, in the non-GDM group, it was shown to be an episiotomy. Interestingly, when assessing the neonatal trauma between both groups, the GDM group was found to have Cephalohematoma and Erb's palsy as the most common presentations of birth trauma. In contrast, in the non-GDM group, cephalohematoma accounted for almost half (45.6%) of the birth traumas.

Figure 1 - Comparison of Neonatal Birth Trauma in Neonates born to mothers with and without GDM



- Compares neonatal birth trauma between neonates born to mothers with and without GDM. It was illustrated that in the non-GDM group, cephalohematoma was the most common birth trauma, whereas, in the GDM group, Erb's palsy was the most prevalent.
- The data analysis also indicated that non-GDM mothers had a lower incidence of maternal trauma. The primary reasons for neonatal trauma in this study group were shown to be fetal distress, poor maternal effort, and shoulder dystocia.

4. Discussion

The prevalence of GDM has been shown to vary globally, with 5.4% (95% CI 3.8–7.8%) of women prevalent in Europe and 10.1% (95% CI 6.5–15.7%) in Eastern and Southern Eastern Asia (Eades, 2017; Malinowska-Polubiec, 2003; Mitanchez, 2014). As a result, 16.4% of neonates were found to be affected by macrosomia, which has been noted within the literature to directly indicate the need for surgical delivery in the event of cephalo-pelvic disproportion (26.3%) and intrauterine fetal asphyxia (35.6%) (Mitanchez, 2015; Nguyen, 2018).

The complications related to the delivery of macrocosmic babies (>4000g and >4500g birth weight, respectively) have been documented, reviewed extensively, and described in Table 4 (Beta et al., 2019). However, complications related to the delivery of macrocosmic babies due to GDM have not been extensively explored in the literature, nor have they been specifically addressed for the Middle Eastern population. Thus, it is essential to highlight that complications may additionally result from the required use of assistance by tools such as forceps, vacuum-assisted delivery, and varied incision requirements. However, their effect on the variation of potential complications in delivery has yet to be extensively specified. Shokri et al. described neonatal birth trauma prevalence as 2.7% (95% CI [1.3, 5.3]), asphyxia as 0.03 % (95% CI [0.02- 0.04]), congenital fractures as 0.03% (95% CI [0.01- 0.08]), congenital injury as 0.02% (95% CI [0.00-0.75]) and soft tissue injury as 0.02 % (95% CI [0.02- 0.03]) (Shokri et al., 2020). While birth trauma is anticipated, the assistance needed at the time of delivery may not be predicted. It may vary between institutions in the context of tool availability and practice preference.

Table 4: Odd ratios of macrocosmic neonates' neonatal complications compared to non-macrocosmic neonates (Beta et al., 2019).

Factors	>4000g BW	>4500g BW
Shoulder Dystocia	9.54 (95% CI, 6.76–13.46)	15.64 (95% CI, 11.31–21.64)
OBPI (Obstetric Brachial Plexus Injury)	11.03 (95% CI, 7.06–17.23)	19.87 (95% CI, 12.19–32.40)
Neonatal Fractures	6.43 (95% CI, 3.67–11.28)	8.16 (95% CI, 2.75–24.23)

Maternal complications related to the delivery of macrosomic babies (>4000g and >4500g birth weight, respectively) have been documented and reviewed extensively and described in Table 5 (Rajab, 2012). Zeki et al. described an increased prevalence of Obstetric Anal Sphincter Injury (OASIs) of 3.6% (95% CI: 2.6–2.7) compared to 2.6% (95% CI: 3.4–2.8; P < 0.001) of women without GDM. They additionally noted a higher risk of OASIs with the use of forceps (aOR 1.76, 95% CI: 1.08–2.86, P = 0.02) or vacuum (aOR 1.89, 95% CI: 1.17–3.04, P = 0.01) in GDM mothers, however, when assisted with an episiotomy with forceps use, the odds ratio of resulting OASIs was lowered significantly for prim parous, multiparous and GDM positive or negative mothers (Yang, 2019).

Table 5: Odd Ratios of maternal complications of macrosomic neonates compared to non-macrosomic neonates (Yang, 2019).

Factors	>4000g BW	>4500g BW
Emergency Cesarean Delivery	1.98 (95% CI, 1.80–2.18)	2.55 (95% CI, 2.33–2.78)
Postpartum Hemorrhage	2.05 (95% CI, 1.90–2.22)	3.15 (95% CI, 2.14–4.63)
Obstetric Anal Sphincter Injury (OASI)	1.91 (95% CI, 1.56–2.33)	2.56 (95% CI, 1.97–3.32)

The results of this study have found that, comparatively, the incidence of trauma-induced complications due to the delivery of specific neonates from mothers diagnosed with gestational diabetes was significantly higher for the maternal population versus the neonatal population observed. Significant incidences of trauma for the maternal population diagnosed with GDM included episiotomy, first-degree tear, lateral vaginal wall tear, second-degree tear, and vaginal laceration. While non-GDM mothers had a lower incidence of maternal trauma, the incidence of episiotomy was significantly increased. The reasoning for this difference is unclear and was not explored in this study. The potential protective feature of an episiotomy to lower the risk of further potential tears is suggested to be further investigated in future research endeavors.

In the reviewed data, the incidence of trauma in the neonatal population did not show statistical significance. While the data collection was dependable and could potentially reflect the general pregnant population of the Kingdom of Bahrain, the sample size is relatively small. The study's limitations included slight variances in practice preferences concerning the choice of assistance tools/options between physicians as well as the population's prevalence of diabetes compared to the global rate. According to the International Diabetes Federation, as of 2013, the Kingdom of Bahrain's recorded incidence of diabetes was 21.8%, compared to the global incidence of the same year, 8.3 %15. This variant in the incidence of Diabetes Mellitus type 2 in the general population may correlate to a potential increased risk of macrosomia, which in turn presents an increased risk of potential complications concerning macrosomic delivery.

In regards to the study's strengths, the data collected was on recent deliveries within the last year. As far as the investigators have noted within the retrospective data, they were current with today's standard of practice for macrosomia delivery protocols. Further investigation is recommended to explore how to better reduce such rates by reviewing preferred methods of assistance between physicians as well as working more closely with the civilian population in reducing and encouraging a reduction in diabetes incidence overall within families.

5. Conclusion

The incidence of birth trauma is an issue that requires more investigation and research in the medical community as it has a significant medical burden on healthcare professionals, mothers, and neonates. Reduction in the rates of DM, especially GDM, is one of the primary keys to reducing the incidence of birth trauma, as is appropriate screening and management, with continued improvements in management strategies that will aid in preventing such complications in the pregnancy process.

Statements and Declarations

This research received no external funding, and the authors declare no conflict of interest. All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organization or those of the publisher, the editors, and the reviewers. Authors are required to state whether ethical approval was sought or not for the present study, especially if the study is a clinical trial or animal experiment. The authors took verbal consent from all participants to use the data.

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