Libyan Med J. 2026;18(7):428-436
https://doi.org/10.69667/lmj.26705
Libyan Medical Journal
https://lmj.ly/index.php/ojs/index eISSN: 3107-0426

Original article

Incidence and Possible Risk Factors of Intraventricular Haemorrhage in the Neonatal Intensive Care Unit in Tripoli, Libya

Ebtesam Elkhazmi, Fadila Algadban*, Duaa Karaboli

Department of Paediatrics, Faculty of Medicine, the University of Tripoli, Tripoli, Libya
Corresponding email. *f.algadban@uot.edu.ly*

Keywords.
Incidence, Risk Factors, Intraventricular Haemorrhage, Neonatal Intensive Care Unit.

ABSTRACT

Intraventricular haemorrhage (IVH) is a serious complication affecting preterm neonates, particularly those with very low birth weight. Despite advancements in neonatal care, IVH remains a significant cause of morbidity and mortality in the NICU. This study aims to explore the maternal and neonatal risk factors contributing to IVH in preterm infants admitted to the NICU. The study included all babies delivered and admitted to the NICU of Tripoli University Hospital who developed intraventricular hemorrhage during a period of 18 months. The total number of babies admitted was 1115; IVH was diagnosed in 65 babies, and these are included in the study. Maternal risk factors, mode of delivery, gestational age, birth weight, and details of NICU admission were recorded, and data were analysed using the SPSS statistical package. The incidence of IVH was 5.38%; 42 were males (64.6%), and 23 were females (35.4%), and 43.1% were classified as preterm, falling within the gestational age range of 30 to 34 weeks. Late preterm births (34 to 37 weeks) accounted for 15.4%; 32.3% were born at term (37 to 42 weeks), and one participant was post-term gestation. The mean birth weight was 2.26 ± 0.92 kg. 58.5% (n=38) were within low birth weight (LBW), 41.5% with normal birth weight (NBW), and no neonates were classified as high birth weight (HBW), 69.3% of neonates had Grade I IVH, 21.5% had Grade II IVH, and 9.2% had Grade III IVH, and none had Grade IV IVH in the study group. We found that 16.9% of the mothers experienced prolonged rupture of membranes. Among the participants, 38.5% reported a history of previous abortion, and 49 (75.4%) were delivered with caesarean section. All participants had a foetal cephalic presentation during delivery, with no cases of breech presentation reported. Maternal hypertension was identified in 20.0%, while a history of chorioamnionitis was in 16.9%. Additionally, maternal DM was observed in 12.3%. Abruptio placentae was reported in 9.2%, and maternal eclampsia was reported in 4.6%. Intraventricular haemorrhage is still considered the most common complication of extreme preterm despite the advancement in neonatal care services. In the present study, factors related to neonatal IVH included premature gestation and low birth weight.

Introduction

Intraventricular haemorrhage (IVH) is an important cause of morbidity and mortality in extremely premature/very low-birthweight (VLBW) infants [**Error! Reference source not found.**,3]. The premature babies are those delivered before completing 37 weeks of gestation, and low birth weight infants are born with a birth weight below 2.5 kg, regardless of gestational age [4]. The low birth weight could be further stratified into low birth weight (1500–2500 g), very-low-birthweight (VLBW, 1000–1499 g), and extremely low birth weight (ELBW, < 1000 g) [5]. The fragility of the premature cerebral vasculature and fluctuations in cerebral blood flow are considered important predisposing factors. In the neonatal literature, the severity of IVH is graded from I to IV, depending on its ultrasound imaging appearance.

According to the Papile system, IVH is divided into grade I, defined as the presence of subependymal haemorrhages alone; grade II, defined as primary IVH without ventricular dilatation; grade III, defined as IVH with ventricular dilatation; and grade IV, defined as IVH with ventricular dilatation and brain parenchymal involvement6. Grade IV IVH is also specified as periventricular haemorrhage, infarction, or parenchymal haemorrhage. According to (reference), Grades I and II were considered mild IVH, while Grades III and IV were considered severe [7]. Recent studies proposed that mild IVH is less likely to cause long-term neurological abnormalities, but severe IVH can negatively influence neurological development and result in death in preterm infants [8-10].

Several maternal risk factors were identified, including chorioamnionitis, maternal hypertension, and mode of delivery [11-12]. Neonatal risk factors included low birth weight, early gestational age, respiratory distress syndrome, early-onset sepsis, metabolic derangements, and prolonged mechanical ventilation [11-12]. Additionally, fluctuations in cerebral blood flow due to patent ductus arteriosus (PDA) were associated with increased IVH severity1.

The known maternal and neonatal risk factors are many, including gestational age, birth weight, asphyxia, hypoxia, infection, coagulation dysfunction, twin pregnancy, placenta abnormalities such as placental abruption, respiratory

Received: *17-05-2026 - **Accepted:** 14-07-2026 - **Published:** 21-07-2026*

Libyan Med J. 2026;18(7):428-436
https://doi.org/10.69667/lmj.26705
Libyan Medical Journal
https://lmj.ly/index.php/ojs/index eISSN: 3107-0426

distress syndrome requiring surfactant treatment, intrauterine infection, disseminated intravascular coagulation, pneumothorax, and mechanical ventilation. Early prediction, diagnosis, and interventions for IVH are essential for improving the survival and quality of life of premature infants. In the literature, the incidence of all grades of IVH in the extremely preterm population varies between 31 and 36% [13-15], while the incidence of severe IVH varies between 10 and 17 [16-18]. For that, identifying maternal and neonatal risk factors is crucial for early intervention and improved outcomes. Our study aimed to identify maternal and neonatal risk factors for the development of IVH in babies admitted to the NICU.

Methods

Study design and setting

A retrospective cohort study of Neonates admitted between 1st June 2023 and 31st December 2024, carried out in the Neonatal Intensive Care Unit at Tripoli University Hospital.

Study population

All babies who were admitted to the NICU and developed IVH during the study period were included.

Study tools

Data was collected from patients' records and statistically analyzed by using the Statistical Package for the social since SPSS version 25.

Data collected

Gestational age, BWT, gender, on-head ultrasound results, maternal pregnancy complications, and perinatal conditions were reviewed to evaluate the association between maternal and neonatal factors and the development of IVH.

Results

Among the 65 neonates included in the study, 42 were males (64.6%), and 23 were females (35.4%) (Table 1).

Table 1. Sex Distribution of Neonates

Category	Frequency	Percentage
Male	42	64.6%
Female	23	35.4%
Total	65	100.0%

The mean gestational age of the study population was 34.1±3.95 weeks. 66.2% of them were preterm, 32.3% were full term, and one neonate (1.5%) was post-term (Table 2).

Table 2. Distribution of Gestational Age in Weeks

Gestational Age (Mean ± SD)	**(34.09 ± 3.95 weeks)**	
Gestational Age Category	Frequency	Percentage
Preterm (< 37 weeks)	43	66.2%
Term (37-42 weeks)	21	32.3%
Post-term (> 42 weeks)	1	1.5%
Total	65	100.0%

As shown in (Table 3), analysis of birth weight data revealed a mean of 2.26 ± 0.92 kg. Birth weight categories were distributed as follows: 58.5% (n=38) of neonates were classified as low birth weight (LBW), 41.5% (n=27) were classified as normal birth weight (NBW), and no neonates were classified as high birth weight (HBW).

Table 3. Distribution of Birth weight

Birth weight (Mean ± SD)	**(2.26 ± 0.92 Kg)**	
Birth weight Category	**Frequency**	**Percentage**
LBW (low birth weight)	38	58.5%
NBW (Normal birth weight)	27	41.5%
HBW (High birth weight)	0	0.0%
Total	65	100.0%

Received: *17-05-2026 -* ***Accepted:*** *14-07-2026 -* ***Published:*** *21-07-2026*

Libyan Med J. 2026;18(7):428-436
https://doi.org/10.69667/lmj.26705
Libyan Medical Journal
https://lmj.ly/index.php/ojs/index eISSN: 3107-0426

Intrauterine Growth Restriction (IUGR) was observed in 17 (26.2%) of neonates, while 48 (73.8%) did not exhibit IUGR (Table 4)

Table 4 Intrauterine Growth Restriction (IUGR)

Category	Frequency	Percentage
Yes	17	26.2%
No	48	73.8%
Total	65	100.0%

Early Neonatal Sepsis was diagnosed in 45 (69.2%) neonates, while 20 (30.8%) did not (Table 5).

Table 5 Early Neonatal Sepsis

Category	Frequency	Percentage
Yes	45	69.2%
No	20	30.8%
Total	65	100.0%

Hypothermia (defined as a temperature below 35°C) was observed in 11 (16.9%) of neonates, as shown in (Table 6) .

Table 6 Hypothermia (>35°C)

Category	Frequency	Percentage
Yes	11	16.9%
No	54	83.1%
Total	65	100.0%

45 (69.3%) of neonates had Grade I IVH, 14 (21.5%) had Grade II, and 6 (9.2%) had Grade III (Table 7).

Table 7 Intraventricular Hemorrhage (IVH) Grade

Category	Frequency	Percentage
Grade I	45	69.3%
Grade II	14	21.5%
Grade III	6	9.2%
Total	65	100.0%

Intubation was performed on 51(78.5%) of neonates, as shown in (Table 8).

Table 8. Intubation

Category	Frequency	Percentage
Yes	51	78.5%
No	14	21.5%
Total	65	100.0%

Prolonged intubation was necessary for 46 (70.8%) of the neonates in the study (Table 9).

Table 9. Prolonged Intubation

Category	Frequency	Percentage
Yes	46	70.8%
No	19	29.2%
Total	65	100.0%

Received: *17-05-2026 -* ***Accepted:*** *14-07-2026 -* ***Published:*** *21-07-2026*

Libyan Med J. 2026;18(7):428-436
https://doi.org/10.69667/lmj.26705
Libyan Medical Journal
https://lmj.ly/index.php/ojs/index *eISSN: 3107-0426*

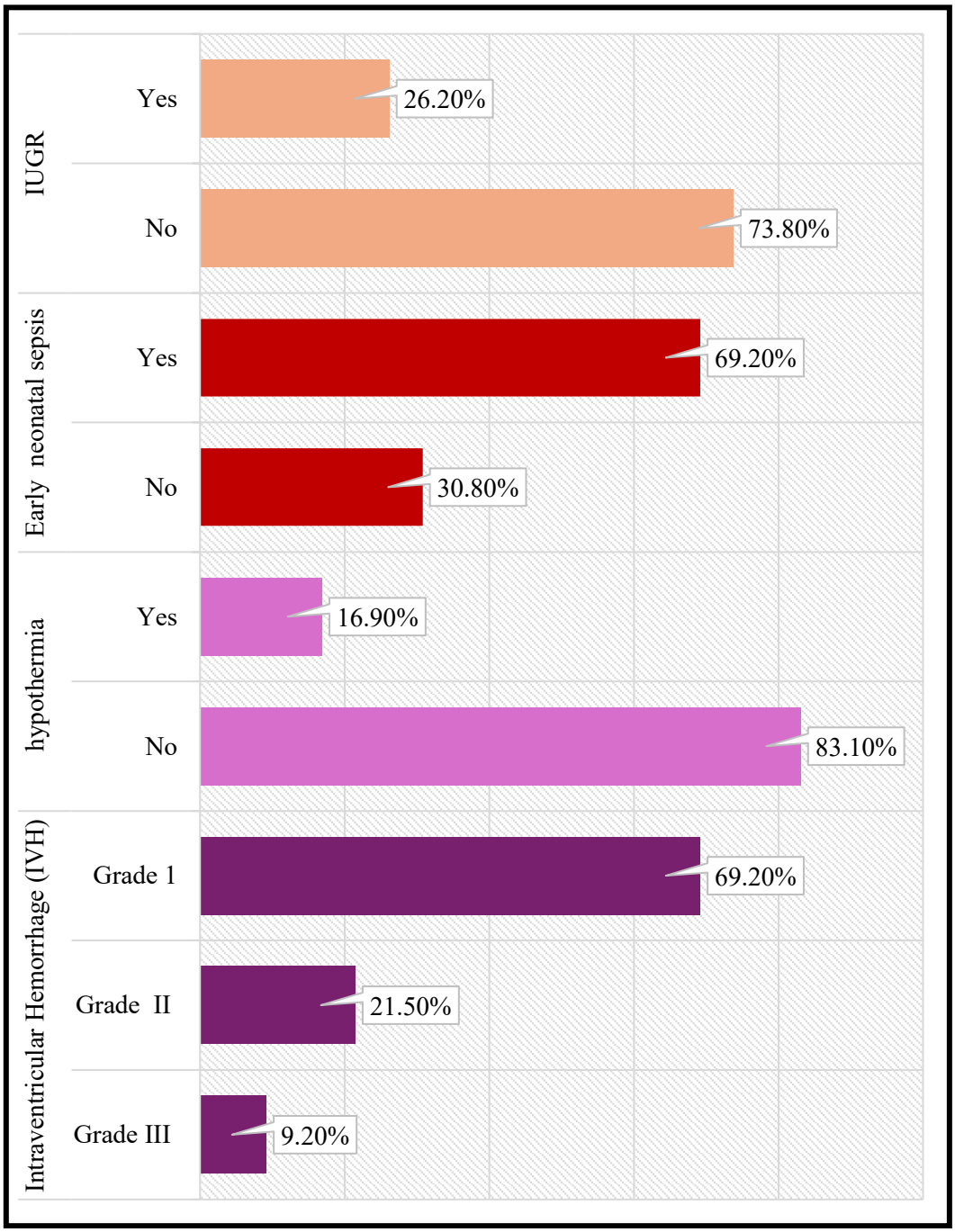

Figure 1. Adverse Neonatal Outcomes

Cardiopulmonary Resuscitation (CPR) was required for 26 (40.0%) of neonates, as shown in (Table 10).

***Table 10 Cardiopulmonary Resuscitation (CPR)*Category**	**Frequency**	**Percentage**
Yes	26	40.0%
No	39	60.0%
Total	65	100.0%

Received: *17-05-2026 -* ***Accepted:*** *14-07-2026 -* ***Published:*** *21-07-2026*

Libyan Med J. 2026;18(7):428-436
https://doi.org/10.69667/lmj.26705
Libyan Medical Journal
https://lmj.ly/index.php/ojs/index eISSN: 3107-0426

Inotropic Support

As shown in (Table 11), Dopamine was the most frequently used inotrope, administered to 42 (64.6%) of neonates. A combination of Dopamine and Dobutamine was utilized in 23 (35.4%), of cases. Dobutamine alone was not used in any neonates within this cohort.

Table 11 Use of Inotropes

Category	Frequency	Percentage
Dopamine	42	64.6%
Dobutamine	0	0.0%
Both (Dopamine & Dobutamine)	23	35.4%
Total	65	100.0%

Fluid Resuscitation

All neonates (100.0%) received a Normal Saline Bolus.

Opioid Infusion

Opioid infusion was administered to 5 (7.7%) of cases (Table 12).

Table 12. Use of Opioid Infusion

Category	Frequency	Percentage
Yes	5	7.7%
No	60	92.3%
Total	65	100.0%

This section provides an overview of the maternal demographics of the study participants, focusing on maternal age and parity.

The mean maternal age in this study was 31.95 ± 5.67 years. The ages of the participants ranged from a minimum of 17 years to a maximum of 42 year

The parity distribution indicates that 23.1% of the participants were primigravida, while 76.9% were multigravida.

Category	Frequency	Percentage
Primigravida (PG)	15	23.1%
Multigravida	50	76.9%
Total	65	100.0%

The data reveals that 11 (16.9%) of the participants experienced prolonged rupture of membranes,

Table 14. Prolonged Rupture of Membranes (PROM > 12 hours)

Category	Frequency	Percentage
Yes	11	16.9%
No	54	83.1%
Total	65	100.0%

History of Previous Abortion

Among the participants, 25 (38.5%) reported a history of previous abortion,

Table 15 History of Previous Abortion

Category	Count	Percentage
Yes	25	38.5%
No	40	61.5%
Total	65	100.0%

History of Fetal/Neonatal Death

The findings indicate that 8 (12.3%) of the participants had a history of fetal or neonatal death.

Table 16 History of Fetal/Neonatal Death

Category	Count	Percentage
Yes	8	12.3%
No	57	87.7%
Total	65	100.0%

Received: *17-05-2026 -* ***Accepted:*** *14-07-2026 -* ***Published:*** *21-07-2026*

Libyan Med J. 2026;18(7):428-436
https://doi.org/10.69667/lmj.26705
Libyan Medical Journal
https://lmj.ly/index.php/ojs/index eISSN: 3107-0426

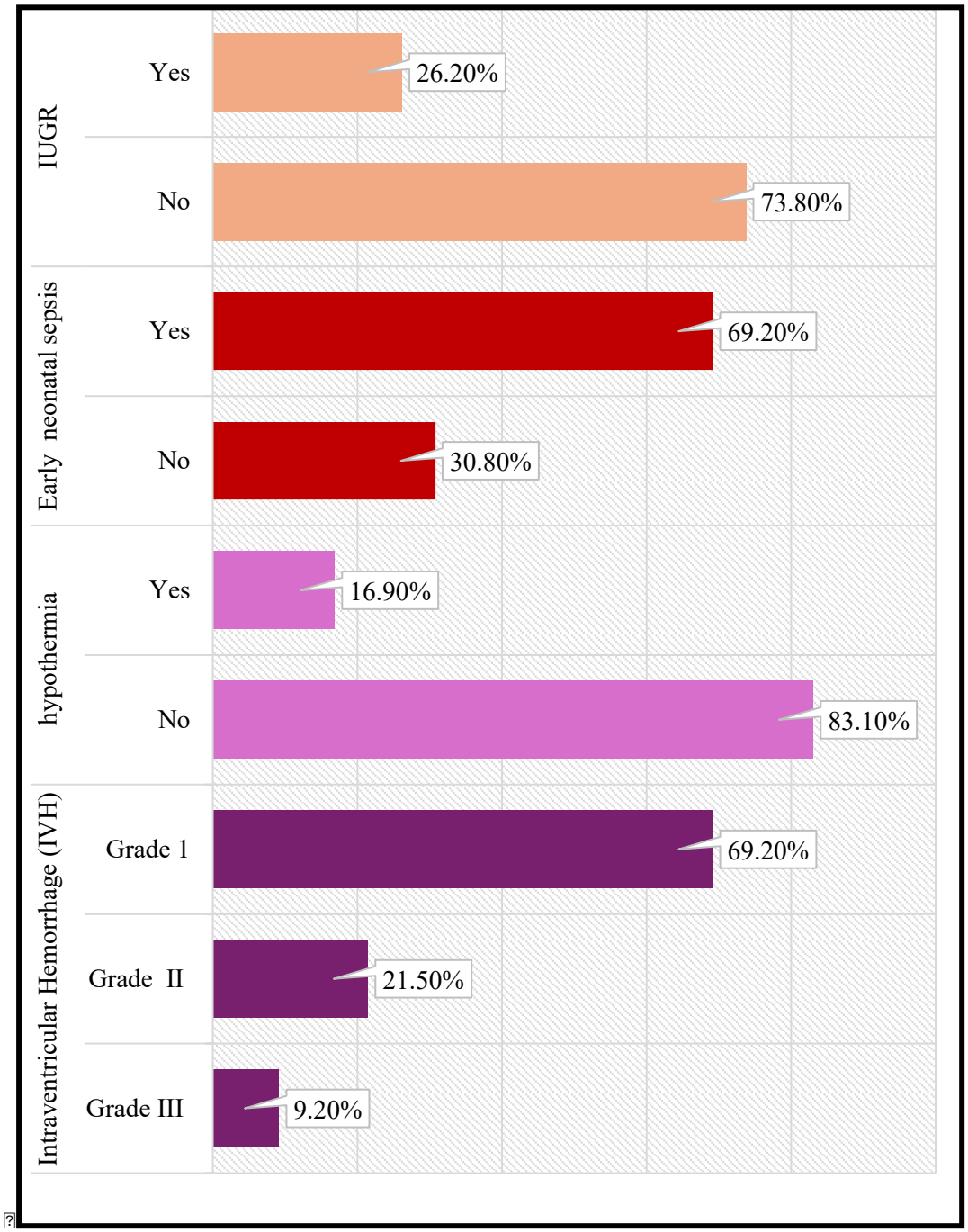

Figure 2 Obstetric History of study participants

The mode of delivery results shows that 16 (24.6%) of the participants had a normal vaginal delivery, while 49 (75.4%) underwent a cesarean section.

Received: *17-05-2026 -* ***Accepted:*** *14-07-2026 -* ***Published:*** *21-07-2026*

Libyan Med J. 2026;18(7):428-436
https://doi.org/10.69667/lmj.26705
Libyan Medical Journal
https://lmj.ly/index.php/ojs/index eISSN: 3107-0426

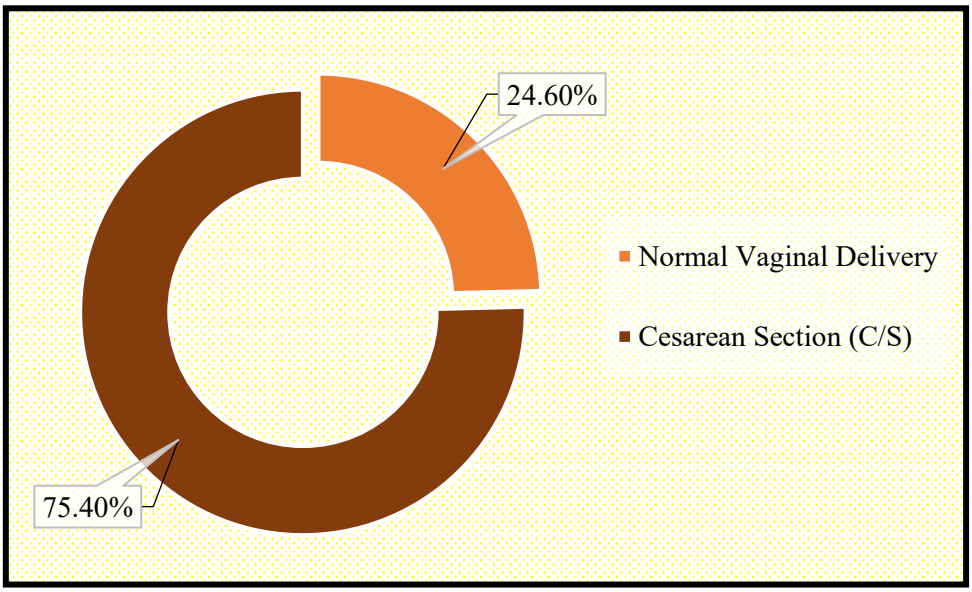

Figure 3. Mode of Delivery

All participants (100%) had a cephalic fetal presentation during delivery, with no cases of breech presentation reported. The type of anesthesia administered during delivery was predominantly epidural, used in 96.9% of cases, while general anesthesia was used in 3.1% of cases.

Table 17 Type of Anesthesia

Category	Count	Percentage
Epidural	63	96.9%
General	2	3.1%
Total	64	100.0%

The administration of drugs such as morphine or magnesium sulfate was minimal, with only one (1.5%) of participants receiving these drugs. The data highlight several significant maternal complications linked to intraventricular hemorrhage (IVH) in neonates. Among the participants, maternal hypertension was identified in 13 cases (20.0%), while a history of chorioamnionitis was present in 11 cases (16.9%). Additionally, maternal diabetes mellitus was observed in 8 cases (12.3%). Other notable complications included a history of abruptio placentae, which occurred in 6 cases (9.2%), and maternal eclampsia, reported in 3 cases (4.6%). These findings suggest potential risk factors associated with IVH in neonates. Importantly, the study did not report any instances of prolonged second stage of labor or history of cord prolapse.

Received: *17-05-2026 -* ***Accepted:*** *14-07-2026 -* ***Published:*** *21-07-2026*

Libyan Med J. 2026;18(7):428-436
https://doi.org/10.69667/lmj.26705
Libyan Medical Journal
https://lmj.ly/index.php/ojs/index eISSN: 3107-0426

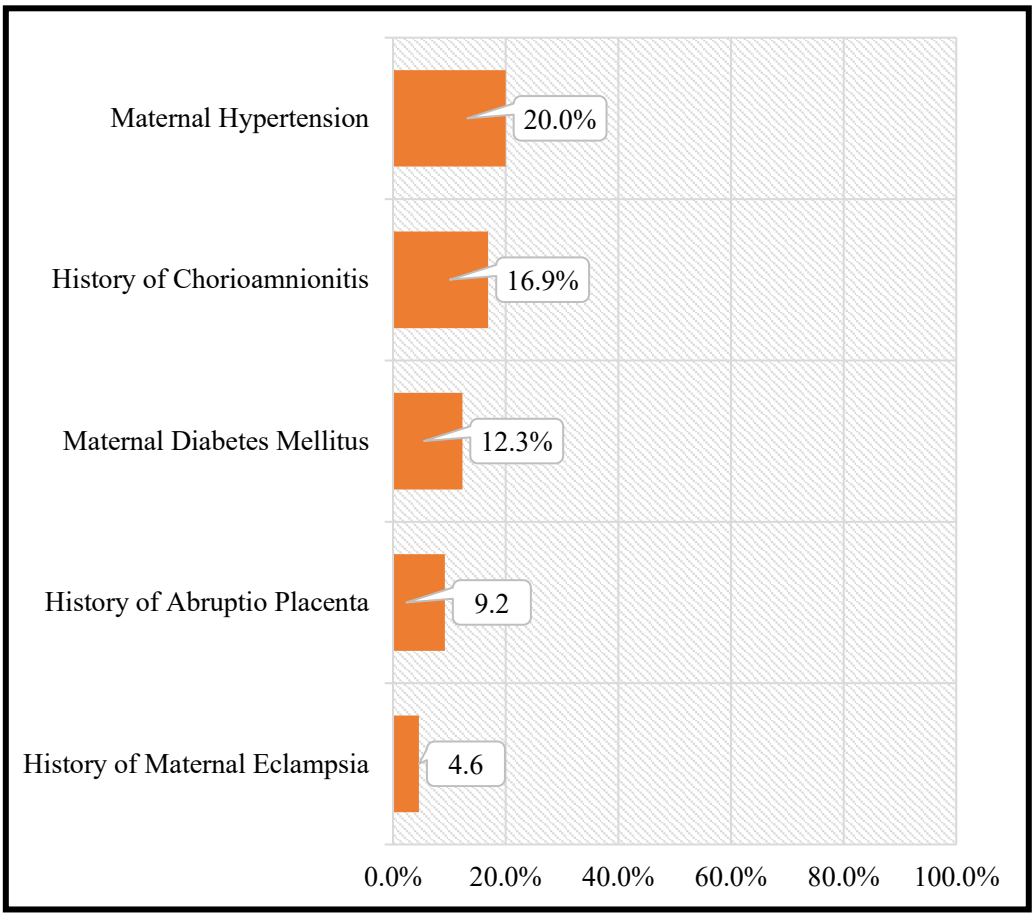

Figure 4. Maternal Complications Associated with IVH in Neonates

Discussion

The current study is conducted on 1115 newborns delivered and admitted to the NICU at Tripoli University Hospital. Our results showed that the incidence of IVH is 5.38%, mostly grade I and II (69.3%) and (21.5%) respectively. And 9.2% for severe grade III. In a very recent Saudi study, the incidence of IVH was 21.8%, mostly grade II IVH (24.1%) [**Error! Reference source not found.**]. While reported as an overall IVH incidence of 27.1% by Allen et.al.

The reported global incidence of grade III-IV ranges between 5% and 52%, and the incidence range of intraventricular haemorrhage grade II was infrequently documented and ranged from 5–19% [**Error! Reference source not found.**], In another study from China conducted on 2,025 preterm babies, the estimated incidence was 3.9 % [**Error! Reference source not found.**].

Our findings align with previous studies, highlighting the significant impact of both maternal and neonatal factors on the incidence and severity of IVH.

The study revealed that the incidence of IVH was higher among male neonates (64.6%) compared to females (35.4%). This gender disparity is consistent with existing literature, suggesting that male neonates may be more susceptible to IVH due to differences in brain development and vulnerability. While Alghadam et al found almost no difference in incidence between males and females (49.6% in males, 50.4% in females) [**Error! Reference source not found.**]. Additionally, the majority of neonates with IVH were preterm (66.2%), with a mean gestational age of 34.09 weeks. Low birth weight was also a significant risk factor, with 58.5% of neonates classified as low birth weight (LBW). These findings underscore the importance of close monitoring and early intervention for preterm and low birth weight infants to mitigate the risk of IVH.

Several maternal factors were identified as potential contributors to IVH. Maternal hypertension was present in 20.0% of cases, while a history of chorioamnionitis was observed in 16.9% of participants [4]. Additionally, maternal diabetes mellitus (12.3%) and abruptio placentae (9.2%) were notable risk factors. These maternal conditions can lead to compromised placental function and foetal hypoxia, increasing the risk of IVH in neonates. The mode of delivery also played a role, with a higher incidence of IVH observed in neonates delivered via caesarean section (75.4%) compared to vaginal delivery (24.6%). This finding suggests that the stress and complications associated with caesarean delivery may contribute to the development of IVH.

Clinical Implications:

The study highlights the need for targeted interventions to reduce the incidence of IVH in high-risk neonates. Early identification of maternal and neonatal risk factors can facilitate timely interventions, such as the administration of

Received: *17-05-2026 -* ***Accepted:*** *14-07-2026 -* ***Published:*** *21-07-2026*

antenatal steroids to enhance fetal lung maturity and reduce the risk of respiratory distress syndrome. Additionally, optimizing delivery practices and providing specialized care for preterm and low birth weight infants can improve outcomes and reduce the burden of IVH.

Conclusion

In conclusion, this study provides valuable insights into the maternal and neonatal risk factors associated with IVH in preterm infants. The findings emphasize the importance of comprehensive prenatal care and early intervention strategies to mitigate the risk of IVH and improve neonatal outcomes. Further research is needed to explore additional risk factors and develop targeted interventions to prevent IVH in vulnerable populations.

References

1. Egesa WI, Odoch S, Odong RJ, et al. Germinal matrix-intraventricular haemorrhage: A tale of preterm infants. Int J Pediatr. 2021;2021:6627612.
2. Gilard V, Tebani A, Bekri S, et al. Intraventricular haemorrhage in very preterm infants: A comprehensive review. J Clin Med. 2020;9(8):2447.
3. Parodi A, Govaert P, Horsch S, et al. Cranial ultrasound findings in preterm germinal matrix haemorrhage, sequelae and outcome. Pediatr Res. 2020;87(Suppl 1):13–24.
4. World Health Organization. Preterm and low birth weight infants. Geneva: World Health Organization; 2023. *[Note: Adjusted to standard NLM format for WHO guidelines/definitions]*
5. Al-Mouqdad MM, Abdelrahim A, Abdalgader AT, Alyaseen N, Khalil TM, Taha MY, et al. Risk factors for intraventricular haemorrhage in premature infants in the central region of Saudi Arabia. Int J Pediatr Adolesc Med. 2021;8(2):76–81.
6. Papile LA, Burstein J, Burstein R, Koffler H. Incidence and evolution of subependymal and intraventricular hemorrhage: a study of infants with birth weights less than 1,500 gm. J Pediatr. 1978;92(4):529–34.
7. Radic JA, Vincer M, McNeely PD. Outcomes of intraventricular haemorrhage and posthemorrhagic hydrocephalus in a population-based cohort of very preterm infants born to residents of Nova Scotia from 1993 to 2010. J Neurosurg Pediatr. 2015;15(6):580–8.
8. Fanaroff AA, Stoll BJ, Wright LL, Carlo WA, Ehrenkranz RA, Stark AR, et al. Trends in neonatal morbidity and mortality for very low birthweight infants. Am J Obstet Gynecol. 2007;196(2):147.e1-147.e8.
9. Reubsaet P, Brouwer AJ, van Haastert IC, Brouwer MJ, Koopman C, Groenendaal F, et al. The impact of low-grade germinal matrix-intraventricular haemorrhage on neurodevelopmental outcome of very preterm infants. Neonatology. 2017;112(3):203–210.
10. Bolisetty S, Dhawan A, Abdel-Latif M, Bajuk B, Stack J, Lui K, et al. Intraventricular haemorrhage and neurodevelopmental outcomes in extreme preterm infants. Pediatrics. 2014;133(1):e55–e62.
11. Khanafer-Larocque I, Soraisham A, Stritzke A, Al Awad E, Thomas S, Murthy P, Kamaluddeen M, Scott JN, Mohammad K. Intraventricular Haemorrhage: Risk Factors and Association With Patent Ductus Arteriosus Treatment in Extremely Preterm Neonates. Front Pediatr. 2019;7:408.
12. Zhao Y, Zhang W, Tian X. Analysis of risk factors of early intraventricular haemorrhage in very-low-birth-weight premature infants: a single centre retrospective study. BMC Pregnancy Childbirth. 2022;22(1):890.
13. Bolisetty S, Dhawan A, Abdel-Latif M, Bajuk B, Stack J, Lui K, et al. Intraventricular haemorrhage and neurodevelopmental outcomes in extreme preterm infants. Pediatrics. 2014;133(1):e55–e62. *[Note: Duplicate of reference #10, format corrected]*
14. Radic JA, Vincer M, McNeely PD. Temporal trends of intraventricular haemorrhage of prematurity in Nova Scotia from 1993 to 2012. J Neurosurg Pediatr. 2015;15(6):573–9.
15. Stoll BJ, Hansen NI, Bell EF, Shankaran S, Laptook AR, Walsh MC, et al. Neonatal outcomes of extremely preterm infants from the NICHD Neonatal Research Network. Pediatrics. 2010;126(3):443–56.
16. Shah PS, Lui K, Sjörs G, Mirea L, Reichman B, Adams M, et al. Neonatal outcomes of very low birth weight and very preterm neonates: an international comparison. J Pediatr. 2016;177:144–152.e6.
17. Shah PS, Sankaran K, Aziz K, Allen AC, Seshia M, Ohlsson A, et al. Outcomes of preterm infants <29 weeks gestation over a 10-year period in Canada: a cause for concern? J Perinatol. 2012;32(2):132–8.
18. Synnes A, Luu TM, Moddemann D, Church P, Lee D, Vincer M, et al. Determinants of developmental outcomes in a very preterm Canadian cohort. Arch Dis Child Fetal Neonatal Ed. 2017;102(3):F235–F234.
19. Alghadam KF, Alomari M, Almehery AA, et al. Incidence and risk factors of intraventricular haemorrhage in premature infants at King Faisal Military Hospital, Southern Region: A retrospective review. Cureus. 2025;17(3):e76274.
20. Siffel C, Kistler KD, Sarda SP. Global incidence of intraventricular haemorrhage among extremely preterm infants: a systematic literature review. J Perinat Med. 2021;49(9):1017–1026.

Received: *17-05-2026 -* ***Accepted:*** *14-07-2026 -* ***Published:*** *21-07-2026*