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Etiology and Short Term Outcome of Neonatal Convulsion in NICU at Benghazi Children Hospital

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Abstract

Background: Neonatal seizures are the most prominent feature of neurological dysfunction during neonatal period, which are abnormal electrical discharges in the central nervous system of neonates, usually manifest as stereotyped muscular activity or autonomic changes, occurring in approximately 1.8 - 3.5/1000 live birth. **Objective:** The aims of study are to determine prevalence rate, natural history, time of onset, etiological factors, clinical types and the short term outcome of neonatal convulsion. **Settings:** This study conducted in Neonatal Department at Benghazi Children Hospital—Libya. **Patients and Methods:** Descriptive cross sectional study, included all neonates who developing clinically identifiable seizures, admitted from 1st of March 2013 to 1st of March 2014. The data collected by using a designed perform including; gender, nationality, residence, place of transfer, gestational age, time of onset, mode of delivery, and history of maternal diseases, family history of neonatal seizures in previous siblings or death, jaundice and exchange transfusion were taken. Details examination include dysmorphic features, weight, head circumference were recorded. Types of seizures were diagnosed by clinical observations, and the etiology of neonatal seizures had been identified from imaging study and from initial relevant investigations which include blood glucose levels, arterial blood gases, serum calcium, electrolytes, phosphate and cerebrospinal fluid examination for evidence of infection. In addition to treatments received, as well as causes of deaths. **Results:** A total of 2842 neonates were admitted to NNW, out of which 150 had seizures. 86 (57%) were male with M:F ratio of 1.3:1. (97%) were Libyan and (76%) from Benghazi, (42%) admitted directly from home. 131 (87%) were term and 15 (10%) preterm. Most of neonatal seizures (76%) were seen in the 1st week of life, and during initial 72 hours of life (63%), with 24% presented in 1st 24 hours of life. Vaginal delivery conducted in 101 (67%), C/S 49 (33%).

Among babies with birth asphyxia, 76% delivered vaginally. 43/150 mothers presented with different medical problems, 32% of them had preeclampsia followed by diabetes in 28%. 127 (85%) babies had normal birth weight and 128 (86%) lie within normal range of head circumference. The most common type of seizure was subtle (48%) followed by clonic (36%). Cranial ultrasound performed to 110 (73%), among them, 16 babies MRI or CT scan were done. The most common cause of seizure was birth asphyxia (30%) followed by infection (16%), hypocalcemia (14%). Phenobarbitone was the most common drug used in treatment (60%), followed by phenytoin (40%) and resistant cases for treatment received pyridoxine (2%). 77 (52%) improved and discharged home without treatment. Mortality rate was 15%; among them 44% from IEM, followed by birth asphyxia 22%. There is strong association between main causes and the outcome with $p = 0.005$. **Conclusion:** The majority of neonates in our study were full term and male. The most common etiology of seizures is birth asphyxia. Hypocalcemia is the most common biochemical abnormality. Subtle represents the commonest type of seizure. Phenobarbitone is still the most commonly prescribed anticonvulsant. Inborn error of metabolism carries a higher mortality rate. Statically analysis showed there is significant association between main causes of neonatal convulsions and the outcome with $p = 0.005$.

Keywords

Neonatal Convulsions, Types, Etiology, Intensive Care, Benghazi, Libya

1. Introduction

A seizure or convulsion is a paroxysmal, time-limited change in motor activity and/or behavior that results from abnormal electrical activity in the brain.

Neonatal seizures by definition occur within the first 4 weeks of life in a full-term infant and up to 44 weeks from conception for premature infants (4 weeks after term) and are most frequent during the first 10 days of life [1].

Seizures are more common in the neonatal period than in any other stage and affect approximately 1% of all neonates, with greater frequency in premature or low birth weight babies as compared to term babies. In the neonatal intensive care units, the incidence goes as high as 10% to 25% out of which about 15% will die and 35% to 40% will have major neurological squeal [2].

Recognition and classification of neonatal seizures remain problematic, particularly when clinicians rely only on clinical criteria. The clinical manifestations of seizures in infants differ from those seen in older children and adults. The problem is in electro-clinical dissociation, where there is no temporal correspondence between electrical paroxysms and repetitive stereotyped motor phenomena. There is at present very little information on which clinicians can base a rational decision about treatment which is often ineffective and does not alter neuro developmental outcome.

Seizures in a newborn are one of the few neonatal neurological emergencies where prompt diagnosis, investigation and treatment are vital as delayed recognition of a treatable cause can have a significant impact on the child's subsequent neurological outcome.

Seizures represent the brain's final common response to insult. The initial injury may be brief, but membrane damage releases excitotoxic substances such as glutamate which triggers further epileptic activity. Magnetic resonance imaging of the brain has shown markedly reduced myelination in children who had suffered from neonatal convulsions [3].

The newborn brain is particularly vulnerable to seizures which are associated with poor neuro developmental outcome. This vulnerability is thought to be due to a combination of enhanced excitability, and low levels of the inhibitory neurotransmitter gamma aminobutyric acid (GABA). That's lead to adverse effect on neurodevelopment and may predispose to cognitive, behavioral or epileptic complication later in life [4] [5].

This study was conducted in neonatal department at Benghazi Children Hospital; it is a referral hospital for all eastern parts of Libya. The department capacity is around 40 incubators, and it is staffed by a highly skilled team from both doctors and nurses. Therefore, the aims of this study were to determine the prevalence rate, the natural history, time of onset, etiological factors, clinical types and to evaluate the short term outcome of neonatal convulsions.

2. Patients and Methods

Study design and sitting: This descriptive cross sectional study was conducted in Neonatal Department at Benghazi Children Hospital; the study period was from 1st of March 2013 to 1st of March 2014.

Study population: The study population consisted of 150 neonates admitted to NICU either through neonatal OPD directly from home or referred from other hospitals. During study period, all neonates of either gender developing clinically identifiable seizures before 28 days of life were enrolled in the study (these babies were either admitted with convulsions or developed them after they were hospitalized).

The data: Data was collected by using a designed perform direct from mothers at admission by author himself as well as by reviewing the medical records of the babies which filled by resident doctors in the unit. A detailed history including; gender, nationality, residence, place of transfer either from private or governmental hospital, gestational age, age at onset, mode of delivery (spontaneous vaginal, instrumental, C-section), obstetrical and antenatal history of maternal diseases as gestational diabetes, pregnancy induced hypertension, family history of neonatal seizures in previous siblings or death, as well as jaundice and exchange transfusion were taken.

Details of examination include dysmorphic features, weight, head circumference were recorded. The etiology of neonatal seizures had been identified either

from imaging study as ultrasound MRI and CT scan results as well as from initial relevant investigations which include blood glucose levels, arterial blood gases, serum calcium, serum electrolytes, serum phosphate and cerebrospinal fluid examination for evidence of infection. In addition to treatments received, as well as causes of deaths.

Diagnostic criteria: Seizure type was diagnosed by clinical observations made by the author or resident doctors, and the etiology was based on laboratory findings, and/or imaging studies of the brain (ultrasonography, CT scan, or MRI). The criteria for diagnosing various biochemical disorders were as follows: hypocalcemia (Ca^{++} < 7.0 mg/dl), hypomagnesemia (Mg^{++} < 1.5 mg/dl), hyponatremia (Na^{+} < 130 mEq/L), hypernatremia (Na^{+} > 150 mEq/L). Hypoglycemia was diagnosed if blood glucose levels were less than 45 mg/dl in term infants, and less than 40 mg/dl in preterm infants. CSF examination was considered abnormal when there were elevated CSF leukocytes, low CSF sugar, elevated CSF protein and/or positive culture.

The main causes of convulsion were written as recorded in the patients' file under the title of diagnosis.

Exclusion criteria: All babies meeting the inclusion criteria were included in the study; exclusion criteria included those with no clear clinical signs of convulsions. Jitteriness or sleep-related muscular activities and other non-seizures movements were differentiated from seizures and excluded.

Data and statistical analysis: The data entry, statistical analysis and calculations were performed with the use of statistical package for social sciences software for windows (SSPS version 18.0).

The data interpreted in tables and figures, the numerical data were shown as percent, minimum and maximum, median, mean ± SD.

Appropriate statistical test of significance like chi-sq test was used as necessary to find the significance of observed difference between the studied variables, and p value < 0.05 was taken as level of significance.

Limitations: There were limitations in some diagnostic investigations in the hospital like investigations for IEM as well as EEG services.

3. Results

Among the 2842 neonates admitted to neonatal care unit during the study period with different medical problems, 150 (5.2%) neonates (term and preterm) developed clinically identifiable seizures and were found eligible for the study.

3.1. Demographic Characteristics

3.1.1 Gender

- Male gender dominated the admissions with 86/150 babies (57%) giving male to female ratio 1.3:1. As shown in **Figure 1**.

3.1.2. Nationality

- Nearly all babies, 146 (97%) were Libyan.

- Only 4 (3%) babies were non Libyan (Syrian). See Figure 2.

3.1.3. Residence and Place of Transfer

- The vast majority of the babies 114 (76%) were from Benghazi; forty eight babies (42%) admitted directly from their homes through hospital neonatal OPD. Other 66 babies transferred from other hospitals including 45 babies from governmental hospitals and 21 babies from private hospitals.
- All babies referred from outside Benghazi were delivered in governmental hospitals and were as follow (10 from Al Bayda, 7 from Ajdabiya, 6 from Al Marj, 5 from Darnah, 2 from Sabha, 2 from Tobruk, 2 from Al Abyar, 1 from Kufra, 1 from Sirt).

Figure 3 and Table 1 below illustrate the residence and place of transfer of all babies.

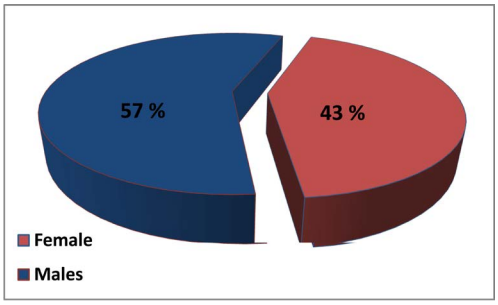

Figure 1. Distribution of babies according to their gender (n = 150).

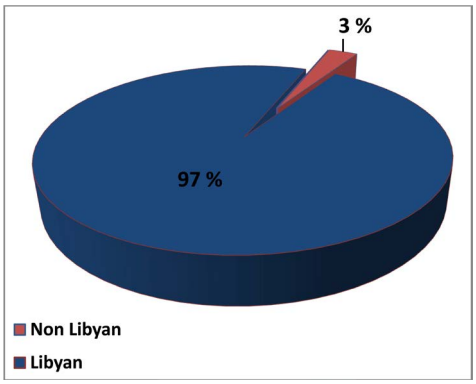

Figure 2. Distribution of babies according to their nationality (n = 150).

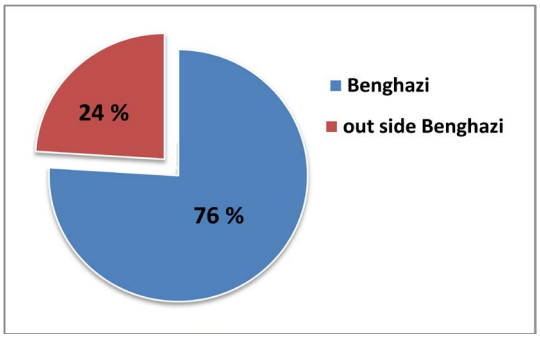

Figure 3. Distribution of babies according to their residence (n = 150).

3.1.4. Gestational Age

According to WHO, preterm is defined as baby born alive before 37 weeks of pregnancy are completed. Term baby, between the complete 37 and 42 weeks while post term baby, after 42 weeks.

- In our study group; the vast majority of babies 131 (87%) were term;
- While 15 (10%) babies were born prematurely;
- Only 4 (3%) babies were post term, as shown in Table 2.

3.1.5. Age at Presentation

- Their age at presentation ranged from birth to 28 days with median 6 days and mean of (8.2 ± 7.1SD).
- We classified the neonatal seizures by age of onset into early onset < 3 days and late onset after 3 days of age.
- Most of the neonatal seizures occurred in the 1st week of life 114 (76%) babies.
- During initial 72 hours of life 94 (63%) babies developed seizures.
- 1st 24 hours or at the time of delivery, seizures were seen in 36 (24%) babies, while in the second and third days 58 (39%) babies and >3 - 7 days, 20 (13%) babies. See Table 3.

Table 1. Distribution of babies according to place of transfer (n = 150).

Place of Transfer	Benghazi		Outside Benghazi	
	No.	%	No.	%
Governmental Hospitals	45	40%	36	100%
Private Hospitals	21	18%	0	0%
Direct from Home	48	42%	0	0%
Total	114	100%	36	100%

Table 2. Distribution of babies according to gestational age (n = 150).

Gestational age	No.	%
Term	131	87%
Preterm	15	10%
Post term	4	3%
Total	150	100%

Table 3. Distribution of babies according to time of onset (n = 150).

Onset type	Time of onset	No.	%
Early onset	1st 24 hours	36	24%
	2 - 3 days	58	39%
Late onset	>3 - 7 days	20	13%
	>7 days	36	24%
Total		150	100%

3.1.6. Mode of Delivery

- Vaginal deliveries were conducted in 101 (67%) mothers, among them 10 (6%) were assisted deliveries; 8 by vacuum and 2 by forceps.
- Cesarean sections were done in 49 (33%) mothers, 39 as elective and 10 emergency.
- Among 45 babies with birth asphyxia, nearly three quarters (76%) delivered vaginally and (24%) by C/S.

Table 4 and Figure 4 below illustrate mode of delivery and its correlation to birth asphyxia.

3.2. Maternal Diseases

- Among 43 mothers with different medical problems, 14 (32%) mothers had preeclampsia. Followed by diabetes in 12 (28%) mothers including; diabetes mellitus type I and II as well as gestational diabetes, 2 babies of these mothers had hypoglycemia while hypocalcemia found in third one.
- Hypocalcemia 6 (14%) mothers, as well as 2 of their babies.
- Three (7%) mothers had epilepsy; the causes of convulsions in their babies were one with hypocalcemia, the second one with hyponatremia and the third one with ICH. As shown in Table 5.

3.3. Birth Weight

According to baby growth chart published by WHO; Normal birth weight ranged from 2.5 - 4.5 kg, and low birth weight (LBW) between 1.5 - <2.5 kg.

- Out of 150 babies, 127 (85%) had normal birth weight with; {36 (24%) babies 2.5 - 3 kg, 57 (38%) babies >3 - 3.5 kg, 34 (23%) babies >3.5 - 4.5 kg.
- Eighteen babies (12%) were LBW (<2.5 kg) included; 15 preterm with 6 (4%) of them less than 2 kg.
- Five (3%) babies were large for gestational age (>4.5 kg). See Table 6.

Table 4. Distribution of babies according to way of delivery (n = 150).

Mode of delivery		No.		%	
C/S	Elective Emergency	49	39 10	33%	26% 7%
Vaginal delivery	Normal Assisted	101	91 10	67%	61% 6%
Total		150		100%	

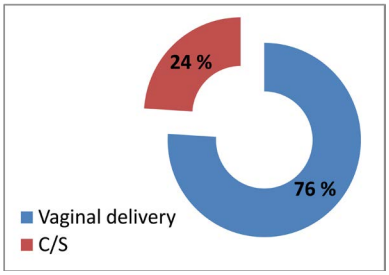

Figure 4. Correlation between birth asphyxia and way of delivery (n = 45).

Table 5. Distribution of babies according to maternal diseases (n = 43).

Maternal diseases	No.	%
Preeclampsia	14	32%
Diabetes	12	28%
UTI	8	19%
Hypocalcemia	6	14%
Epilepsy	3	7%
Total	43	100%

Table 6. Distribution of babies according to birth weight (n = 150).

Birth weight/kg	No.	%
1.5 - <2.5	18	12%
2.5 - 4.5	127	85%
>4.5 - 5	5	3%
Total	150	100%

3.4. Head Circumference

According to WHO, normal range of head circumference in term newborn is 35 ± 2 cm.

- The vast majority of the babies 128 (86%) lie within normal range.
- Seventeen (11%) babies, their head circumference were less than 33 cm, among them 15 were preterm babies.
- Five (3%) babies were above 37 cm. As shown in Table 7.

3.5. Types of Convulsions

- Nearly half of the babies 72 (48%) had subtle convulsion.
- More than one third 54 (36%) babies had clonic convulsion.
- Tonic in 20 (13%) babies.
- Only four babies (3%) had myoclonic convulsion. See Table 8.

3.6. Imaging Done

- For the most of babies, 110 (73%) cranial ultrasound was performed, additional imaging CT or MRI was done to 16/110 as guided according to history, physical examination and investigations, which reviled 5 babies with ICH and 20 babies with brain edema. As shown in Table 9.

3.7. Main Causes of Neonatal Convulsions

- Frequency of causes of fits was birth asphyxia which considered as a leading cause of convulsions 45 (30%) babies; Twenty nine of them were an isolated asphyxia and the remaining 16 babies additional problems coexist with birth asphyxia like hypocalcemia 7 babies, electrolyte disturbances 5 and hypoglycemia 4

Table 7. Distribution of babies according to head circumference (n = 150).

Head circumference/cm	No.	%
<33	17	11%
33 - 37	128	86%
>37	5	3%
Total	**150**	**100%**

Table 8. Distribution of babies according to type of convulsions (n = 150).

Type of convulsions	No.	%
Subtle	72	48%
Clonic	54	36%
Tonic	20	13%
Myoclonic	4	3%
Total	150	100%

Table 9. Distribution of babies according to imaging.

Types of imaging	No.
Cranial US	110/150
CT	12/110
MRI	4/110
EEG	0

babies but the exact contribution of these abnormalities as a cause of seizures is not certain. Another 3 babies had associated aspiration pneumonia.

- Infections, which include sepsis 13 (9%) babies and meningitis 11 (7%) babies; among them 3 babies had hypocalcemia, two had electrolyte disturbances and only one with hypoglycemia.
- Biochemical abnormalities; a variety of biochemical abnormalities were demonstrated in 48 babies as a primary cause of seizures including:
  - Hypocalcemia is the commonest one with 21 (14%) babies; among them IDM with TTN, duodenal atresia and operated infantile sacrococcygeal teratoma one baby each, also 2 babies had history of hypocalcemia in their mothers.
  - Electrolyte disturbances 12 (9%) babies; with 7 babies had hypernatremia. 5 babies had hyponatremia, one of them had necrotizing enterocolitis and the other one aspiration pneumonia.
  - Hypomagnesemia seen in 3 babies.
  - Hypoglycemia in 12 (14%) babies; among them congenital heart disease and IDM 2 babies each.
- Inborn error of metabolism 15 (10%) babies; four of them diagnosed as maple syrup urine disease and one as organic acidaemia. The others 10 just diagnosed

clinically as well as from family history and from course of the disease.

- CNS structural defects 9 (5%) babies; 6 with hydrocephalus (two edwards syndrome and one robinow syndrome), one with operated encephalocele, one patau syndrome with holoprosencephaly, and other one with operated meningiocele.
- Intracranial hemorrhage (IVH) 5 (3%) babies, all were preterm.
- Four (3%) babies had kernicterus; their total serum bilirubin were as follow: 26.2, 28.7, 37, 38.2 mg/dl. one of them had hypocalcemia.

Table 10 and Table 11 below illustrate main causes of convulsion and coexistence biochemical abnormalities with the main causes.

3.8. Medications

All babies received one or more types of treatments during their admission:

- Nearly two third 90 (60%) babies received phenobarbitone as 1st line of treatment, followed by Phenytoin 63 (40%) babies. Dextrose 10% was given to 42 (28%) and Calcium gluconate to 15 (10%) babies, resistant cases for treatment received Pyridoxine (2%).
- 50/150 (33%) babies discharged on anticonvulsant treatment; the vast majority of them (88%) discharged with one drug only. Six (12%) babies with two drugs; 4 babies with (oral Luminal and calcium gluconate), others 2 with (oral Luminal and Clonazepam).

Table 12 and Table 13 below show the medications used during admissions and after discharge.

3.9. The outcome

- Seventy seven (52%) babies improved and discharged home without treatment in satisfactory condition.
- Fifty (33%) babies discharged with treatment.
- Twenty three (15%) babies were died. As shown in Figure 5.

3.10. The Correlations

3.10.1. Correlation between Babies's Gender and the Outcome

- Half of babies in both gender discharged without treatments.
- Death rate was nearly the same in both gender with 15% in male and 16% in female. As shown in Table 14.
- There is no significance association between baby's gender and the outcome with $p = 0.960$.

3.10.2. Correlation between Babies's Residence and the Outcome

- According to residence, there is no difference in both group of babies regarding to treatments at discharge or in death rate. See Table 15.
- There is no significance association between baby's residence and the outcome with $p = 0.912$.

3.10.3. Correlation between Gestational Age and the Outcome

- One third of preterm babies were discharged without treatments versus 53% in term babies.
- In spite of that preterm babies had a higher rate 40% of treatments needed at discharged as well as higher death rate with 27% versus 33%, 14% respectively in term babies, there is no significance association between gestational age and the outcome with p = 0.455. As shown in Table 16.

Table 10. Distribution of babies according to main causes of convulsions (n = 150).

Main causes	No.	%
Birth asphyxia	45	30%
Infection*	24	16%
Biochemical abnormalities		
Hypocalcemia	21	14%
Electrolyte disturbances	12	8%
Hypoglycemia	12	8%
Hypomagnesemia	3	2%
Inborn Error of Metabolism	15	10%
CNS structural defects	9	6%
Intra Cranial Hemorrhage (IVH)	5	3%
Kernicterus	4	3%
Total	150	100%

*Sepsis and meningitis.

Table 11. Biochemical abnormalities and main causes of convulsions.

Main causes	Biochemical abnormalities				
	Hyponatremia	Hypernatremia	Hypomagnesemia	Hypocalcemia	Hypoglycemia
Birth asphyxia	2	3	0	7	4
Meningitis	0	1	0	2	1
Sepsis	1	0	0	1	0
Hypocalcemia	0	0	0	21	0
Hypornatremia	5	0	0	0	0
Hypernatremia	0	7	0	0	0
Hypoglycemia	0	0	0	0	12
Hypomagnesemia	0	0	3	0	0
IEM	0	0	0	1	0
CNS s.d	0	0	0	1	0
ICH	0	0	0	0	0
Kernicterus	0	0	0	1	0
Total	8	11	3	34	17

N.B.: CNS s.d = CNS structural defects, IEM = Inborn Error of Metabolism, ICH = Intra Cranial Hemorrhage.

Table 12. Medications received during admission (n = 150).

Medications	Babies No.	%
Phenobarbitone	90	60%
Phenytoin	63	40%
Dextrose 10%	42	28%
Calcium gluconate	15	10%
Magnesium sulphate	10	7%
Diazepam	9	6%
Midazolam	8	5%
Clonazepam	4	3%
Pyridoxine	3	2%

Table 13. Distribution of babies according to medications at discharge (n = 50).

Medications at discharge	No.	%
One drug	44	88%
Two drugs	6	12%
Total	50	100%

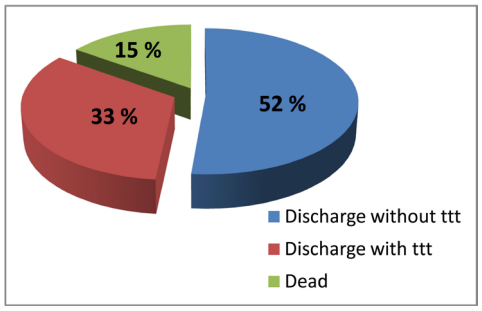

Figure 5. Distribution of babies according to their outcome (n = 150).

Table 14. Correlation between babies' gender and the outcome.

Outcome	Gender				Total
	Male		Female		
	No.	%	No.	%	
Discharge without ttt	45	52%	32	50%	77
Discharge with ttt	28	33%	22	34%	50
Died	13	15%	10	16%	23
Total	86	100%	64	100%	150

Chi-Square Tests: $\chi^2 = .081$, df = 2, p = 0.960.

Table 15. Correlation between babies' residence and the outcome.

Outcome	Residence				Total
	Benghazi		Outside Benghazi		
	No.	%	No.	%	
Discharge without ttt	58	51%	19	53%	77
Discharge with ttt	39	34%	11	30%	50
Died	17	15%	6	17%	23
Total	114	100%	36	100%	150

Chi-Square Tests: $\chi^2 = 0.184$, df = 2, p = 0.912.

Table 16. Correlation between gestational age and the outcome.

Outcome	Gestational age						Total
	Preterm		Term		Post term		
	No.	%	No.	%	No.	%	
Discharge without ttt	5	33%	69	53%	3	75%	77
Discharge with ttt	6	40%	43	33%	1	25%	50
Died	4	27%	19	14%	0	0%	23
Total	15	100%	131	100%	4	100%	150

Chi-Square Tests: $\chi^2 = 3.651$, df = 4, p = 0.455.

3.10.4. Correlation between Age at Presentation and the Outcome

- There is no difference in babies who presented early or late with convulsion, where nearly half of babies in both group discharged without treatments as well as death rate was nearly similar in both group. See Table 17.
- There is no significance association between age at presentation and the outcome with p = 0.999.

3.10.5. Correlation between Way of Delivery and the Outcome

- There is no difference in the outcome between babies who delivered vaginally or by C/S, where half of them discharged without treatments with nearly equal percentages of death, 16% and 14% respectively. As shown in Table 18.
- There is no significance association between way of delivery and the outcome with p = 0.954.

3.10.6. Correlation between Main Causes and the Outcome

- Prognosis was poor in babies with IEM followed by ICH, CNS structural defects and kernicterus where the death rate was 67%, 60%, 33% and 25% respectively. While babies with birth asphyxia 21/45 (47%) of them discharged with anticonvulsant therapy as well as 4/15 (27%) with IEM. See Table 19.
- There is significance association between main causes of neonatal convulsions and the outcome with p = 0.005.

Table 17. Correlation between time of onset and the outcome.

Outcome	Time of onset								Total
	Early				Late				
	1st 24 h		2 - 3 days		>3 - 7 days		>7 days		
	No.	%	No.	%	No.	%	No.	%	
Discharge without ttt	18	50%	30	52%	11	55%	18	50%	77
Discharge with ttt	12	33%	20	35%	6	30%	13	36%	50
Dead	6	17%	8	13%	3	15%	5	14%	23
Total	36	100%	58	100%	20	100%	36	100%	150

Chi-Square Tests: $\chi^2 = 0.111$, df = 4, p = 0.999.

Table 18. Correlation between way of delivery and the outcome.

Outcome	Way of delivery				Total
	Vaginal delivery		C/S		
	No.	%	No.	%	
Discharge without ttt	52	51%	25	51%	77
Discharge with ttt	33	33%	17	35%	50
Died	16	16%	7	14%	23
Total	101	100%	49	100%	150

Chi-Square Tests: $\chi^2 = 0.094$, df = 2, p = 0.954.

Table 19. Correlation between main causes and the outcome.

Outcome	Main causes of convulsions										Total
	Birth asphyxia	Infection	Hypocalcemia	Electrolyte disturbances	Hypoglycemia	Hypomagnesemia	Inborn Error of Metabolism	Intra Cranial Hemorrhage	CNS structural defects	Kernicterus	
Discharge without ttt	19	15	17	8	10	3	1	0	2	2	77
Discharge with ttt	21	8	4	4	2	0	4	2	4	1	50
Died	5	1	0	0	0	0	10	3	3	1	23
Total	45	24	21	12	12	3	15	5	9	4	150

Chi-Square Tests: $\chi^2 = 39.753$, df = 20, p = 0.005.

3.11. Analysis of Death

Out of 150 babies 23 (15%) babies were died:

- The major cause of death was inborn error of metabolism 10/23 (44%), followed by birth asphyxia 5/23 (22%) babies.

Table 20. Distribution of babies according to causes of deaths (n = 23).

Causes of deaths	No.	%
Inborn error of metabolism	10	44%
Birth asphyxia	5	22%
Intra cranial hemorrhage	3	13%
CNS structural defects	3	13%
Infection	1	4%
Kernicterus	1	4%
Total	23	100%

- Among babies with CNS structural defects three (13%) died; two edwards and one patau syndrome.
- While one baby died from kernicterus as well as one from infection. As shown in Table 20.

4. Conclusions

- The majority of neonates who developed seizures were male and full term.
- The most common etiology of seizures is birth asphyxia.
- Hypocalcemia is most common biochemical abnormality.
- Subtle represents the commonest type of seizure.
- Phenobarbitone is still the most commonly prescribed anticonvulsant.
- Inborn error of metabolism carries a higher mortality rate.
- Statically analysis showed there is significant association between main causes of neonatal convulsions and the outcome with p = 0.005.

5. Recommendations

Regular updating of the data is recommended with increasing attention to save the data electronically. Improvement of antenatal services and obstetrical care with regular monitoring of fetal heart rate to ensure safe delivery and appropriate neonatal resuscitation to avoid birth asphyxia; Improvement of the laboratory services and the availability of investigations and other advanced procedures to detect and diagnose an inborn error of metabolism. EEG services are strongly needed in the unit. Quick assessment, timely diagnosis and aggressive management according to the etiology are necessary to prevent the morbidity and mortality associated with neonatal seizures. Future studies should include large sample size and should include other hospitals in our locality; in addition we recommend prospective studies which focus on the long term neurological and developmental outcome following neonatal seizures.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Abbreviations

ABG	Arterial blood gas
AED	Antiepileptic drug
CNS	Central nervous system
C/S	Cesarean section
CSF	Cerebrospinal fluid
CT	Computed tomography
EEG	Electroencephalography
GABA	Gamma amino-butyric acid
HIE	Hypoxic-ischemic encephalopath
IEM	Inborn error of metabolism
ICH	Intra cranial hemorrhage
IM	Intramuscular
IV	Intravenous
LBW	Low birth weight
MRI	Magnetic resonance imaging
MSUD	Maple syrup urine disease
NICU	Neonatal intensive care unit
NNW	Neonatal ward
NS	Neonatal seizures
UTI	Urinary tract infectio
US	Ultrasound
TTN	Transient tachypnea of newborn
ttt	Treatment