e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2021; 13(6); 922-930

Original Research Article

A Study on the Incidence and Risk Factors of Neonatal Jaundice Necessitating Phototherapy

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Received: 10-04-2021 / Revised: 13-05-2021 / Accepted: 25-06-2021

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Conflict of interest: Nil

Abstract:

Background: Neonatal jaundice is a common neonatal disorder that is manifested by a condition called hyperbilirubinemia, which results in yellow coloured sclera and skin. Hyperbilirubinemia in the neonate often is an innocent problem; however, if it is allowed to exist for a long period of time without appropriate treatment, it can evolve into a severe form of neonatal jaundice called acute bilirubin encephalopathy and kernicterus. Neonatal jaundice that requires phototherapy is one of the leading causes of morbidity in the neonatal period.

Aim: To determine the incidence of neonatal jaundice requiring phototherapy treatment and the risk factors associated with neonatal jaundice among neonates admitted to the tertiary care teaching hospital.

Methodology: At Gouri Devi Institute of Medical Sciences and Hospitals in the Department of pediatrics, a retrospective study involving review of medical records will be done on 180 neonate patients recorded in their medical files at Gouri Devi Institute of Medical Sciences and hospitals. Information regarding demographics of neonates, gestational age, birth weight, feeding method, lab values, bilirubin level, risk factors, and outcome of treatment were collected.

Results: Most of the newborns (i.e., babies from 1-28 days old) were boys, with nearly 59%, and nearly 69% were full term, with only a very small percentage (i.e., 28%) having been born with low birth weight. The top five risk factors for developing jaundice needing treatment with phototherapy were being premature, with about 31% of premature babies developing jaundice (31.1%); having been born with a low birth weight (27.8%); exclusively being breastfed but having difficulty feeding (22.2%); having ABO incompatibility (18.9%); and having underlying sepsis (15.0%). Of all of the newborns with a high serum bilirubin level over the treatment threshold, only 40% of the babies were receiving phototherapy treatment. The most common type of treatment was conventional phototherapy (72.2%), with very few babies receiving intensive phototherapy (11.1%) or exchange transfusion (3.3%).

Conclusion: Many factors are used to determine jaundice that requires phototherapy in newborns. Some of these are feeding difficulties, neonatal infections, incompatible blood groups, low birth weight and prematurity. It is important to identify the newborns at risk, check the bilirubin levels and initiate early treatment with phototherapy to avoid future complications associated with hyperbilirubinemia.

Keywords: Neonatal jaundice, Hyperbilirubinemia, Phototherapy, Prematurity, Low birth weight, Neonates, Risk factors.

Introduction

Neonatal jaundice is a prevalent medical condition among neonates that is caused by high levels of bilirubin in the blood that leads to yellowing of the skin, the eyes (sclera) and mucous membranes [1]. The cause of neonatal jaundice is attributed to the increased bilirubin production, low bilirubin conjugation ability of the liver, and increased enterohepatic circulation in neonates. While physiologic jaundice typically is not severe and will clear up on its own, if it progresses to acute bilirubin encephalopathy and kernicterus, it can be life-threatening, with severe neurologic sequalae, and death if left untreated or undiagnosed. Neonatal jaundice is hence an important health issue associated with neonates around the globe [2].

Clinical awareness of the importance of neonatal jaundice has greatly expanded in view of the increased understanding of neurological dysfunction caused by bilirubin and its long-term implications for neurodevelopmental outcome [3]. Now neonatal jaundice is no longer regarded as a physiological phenomenon but, thanks to the progress of neonatal

medicine and the development of laboratory diagnostics, there is a better understanding of bilirubin metabolism and the pathological mechanisms responsible for hyperbilirubinemia. The importance of early detection, bilirubin monitoring and timely intervention to avoid development of serious complications have been emphasized in modern guidelines for neonatal care. Neonatal health organizations have established standard guidelines for the treatment of hyperbilirubinemia in the neonate, which include parameters such as serum bilirubin level, gestational age, and risk factors for hyperbilirubinemia, and when to begin phototherapy treatment [4].

Treatment of non-physiological neonatal jaundice in which medical intervention is needed is still the same, namely phototherapy [5]. Therapy involves transformation of unconjugated bilirubin into water soluble photo isomers, which are excreted unconjugated. Since its introduction, phototherapy has proven to be an important treatment method in neonatal care, and has significantly reduced the rate of exchange transfusion and kernicterus. Hyperbilirubinemia is a serious condition in neonates, despite treatment with intensive phototherapy and prolonged hospital stay, and a high percentage of them still develop severe hyperbilirubinemia, particularly in low- and middle-income countries where facilities and screening programmes may not be sufficient [6]. Hence, detection of neonates who are at higher risk of developing severe hyperbilirubinemia is crucial to improve neonatal outcomes and decrease complications.

There are many causes of jaundice in neonates. Pathological hyperbilirubinemia may be caused by a variety of factors including, but not limited to, low birth weight, blood group incompatibility, sepsis, exclusive breastfeeding with inadequate intake, trauma at delivery, dehydration and preterm delivery [7]. Immature enzymatic processes in liver of premature neonates lead to a limited capability of bilirubin conjugation. With hemolytic diseases like ABO and Rh incompatibility, bilirubin becomes overloaded causing a greater than expected breakdown of red blood cells. In the same way, disorders in liver function in removal of bilirubin and its metabolism during the neonatal period and during birth asphyxia, both predispose to the development of jaundice. Knowing these risk factors can be important in preventing this condition [8].

Newborn jaundice is not just a health issue in the USA, but rather a global health problem in every geographical and socio-economic category of the world. It has been found through epidemiological research that 60% of full-term newborns and close to 80% of premature newborns become jaundiced within the first week of their lives [9]. Neonatal severe jaundice is still common in developing nations owing to lack of advanced neonatal ICUs, poor post-operative health, poor parental knowledge, and late medical treatment. The rising rate of admissions for hyperbilirubinemia and its consequences has been seen in research carried out in South Asia and Africa. Jaundice accounts for a huge percentage of neonatal ICU admissions in India and results in considerable morbidity in the nation [10].

Neonatal jaundice causes clinical problems and impacts the family and healthcare systems economically and emotionally. The financial burden of prolonged hospitalisation, multiple laboratory tests, intensive monitoring and treatment places strain on families, particularly in low resource areas. Parents with severely jaundiced neonates may feel anxiety and emotional upset due to risk of neurological problems and extended time apart from their infant upon admission to the NICU. Furthermore, extreme hyperbilirubinemia causing kernicterus may cause neurological disability for life, hearing impairment, cerebral palsy, and developmental delay which will impact the child's and family's quality of life [11].

Early recognition of a neonate at risk for hyperbilirubinemia and immediate treatment with phototherapy can lower neonatal morbidity and mortality in several studies [12]. The incidence and risk factors, however, are different in various populations due to genetic factors, feeding habits, socioeconomic conditions, mother's health and access to neonatal health care. Therefore, to be able to define the epidemiological profile and the factors associated with neonatal jaundice, local studies need to be conducted to gain an understanding of the epidemiology in the various health care environments. These studies can assist in the design of evidence-based approaches to the screening, prevention and management of neonatal hyperbilirubinemia [13].

The present study aimed to make a retrospective study of the incidence and the associated risk factors of neonatal jaundice requiring phototherapy among neonates admitted to a tertiary care teaching hospital [14]. The purpose of the study is to investigate neonatal and maternal clinical information to find the common risk factors and treatment outcome of neonatal hyperbilirubinemia. Study results can help develop more effective early diagnosis, prevention and treatment plans for neonatal jaundice that could improve neonatal health and minimize adverse outcomes due to severe hyperbilirubinemia [15].

Methodology

Study Design: The purpose of this study was to conduct a retrospective observational study to determine the incidence and risk factors of neonatal jaundice which required phototherapy. The study involved the collation and analysis of existing clinical data to determine demographic, neonatal, maternal and clinical risk factors for neonatal hyper-

bilirubinemia that necessitated the use of phototherapy. Therefore, a retrospective approach was chosen, to analyze the records of the hospitals within a fixed time period and to get a broad picture of the prevalence and causes of neonatal jaundice among the newborn admitted to the neonatal intensive care unit and the pediatric ward.

Study Area: This study was carried out in the Department of Pediatrics, Gouri Devi Institute of Medical Sciences & Hospital. Gouri Devi Institute of Medical Sciences & Hospital, Durgapur, West Bengal

Study Duration: The study was carried out for 1 year.

Study Participants

Inclusion Criteria

- Neonates (0-28 days) who were diagnosed with neonatal jaundice at the study center.
- Neonates that needed phototherapy based on routine, and according to, neonatal treatment guidelines.
- Medical records of neonates with complete demographic information, laboratory investigations, bilirubin level and treatment data.
- Neonates who were admitted to neonatal intensive care unit (NICU) or pediatric ward during the study period.

Exclusion Criteria

- Neonates with major congenital malformations or chromosomal abnormalities.
- Neonates who have incomplete or missing medical records.
- All neonates who had to be exchanged immediately at admission.
- Severe systemic disorders that are unrelated to neonatal jaundice, but may affect bilirubin metabolism, in neonates.

Sample Size: A total of 180 neonatal records with inclusion criteria were selected for the study. The sample was chosen in order to be well representative for neonates ranging from varying levels of gestational age, birth weight, and clinical presentation of neonatal jaundice that needed phototherapy.

Procedure: The medical records department of the hospital was used to obtain neonatal records and systematically reviewed. Information on demographic factors, gestational age, birth weight, sex, delivery method, maternal blood group, neonatal blood group, feeding practices, the onset of jaundice, serum bilirubin level, clinical conditions associated with jaundice and outcomes of treatment was extracted. The following risk factors were assessed: prematurity, low birth weight, ABO incompatibility, Rh incompatibility, sepsis, birth asphyxia and breastfeeding-related jaundice. Assessment of the need for phototherapy, length of treatment and clinical results were also evaluated. A structured proforma was used for data collection with a view to achieve uniformity and accuracy. All patients' records were anonymized and ethical clearance was given by the hospital's Institutional Ethics Committee.

Statistical Analysis: The results collected were analyzed with the use of Statistical Package for Social Sciences (SPSS) version 27.0 (IBM, USA). The continuous variables were calculated using mean, SD, frequency and percentage. The differences between clinical and demographic variables and cases requiring neonatal phototherapy were analysed by chi-square tests and t-test, respectively. Multivariate logistic regression was performed to identify predictors and risk factors for neonatal jaundice that needed phototherapy. A p value of less than 0.05 was considered to be statistically significant.

Result

The demographic and neonatal characteristics of the 180 neonates included in the study are shown in Table 1 below. Gender distribution showed that male neonates were more common than females since males formed 105 neonates (58.3%) compared to females that had 75 neonates (41.7%). For gestational age, there were 124 neonates (68.9%) that were full-term while there were 56 neonates (31.1%) that were preterm. The results from the birth weight analysis show that neonates that were of normal birth weight (≥ 2.5kg) represented 72.2% while those with low birth weight (< 2.5kg) accounted for 27.8%. Mode of delivery was also taken into consideration with 112 neonates (62.2%) delivered by vaginal delivery, and 68 neonates (37.8%) delivered by cesarean section.

Table 1: Demographic and Neonatal Characteristics of Study Participants

Parameter	Category	Frequency (n)	Percentage (%)
Gender	Male	105	58.3
	Female	75	41.7
Gestational Age	Preterm	56	31.1
	Term	124	68.9
Birth Weight	Low birth weight (<2.5 kg)	50	27.8
	Normal birth weight (≥2.5 kg)	130	72.2
Mode of Delivery	Vaginal Delivery	112	62.2
	Cesarean Section	68	37.8

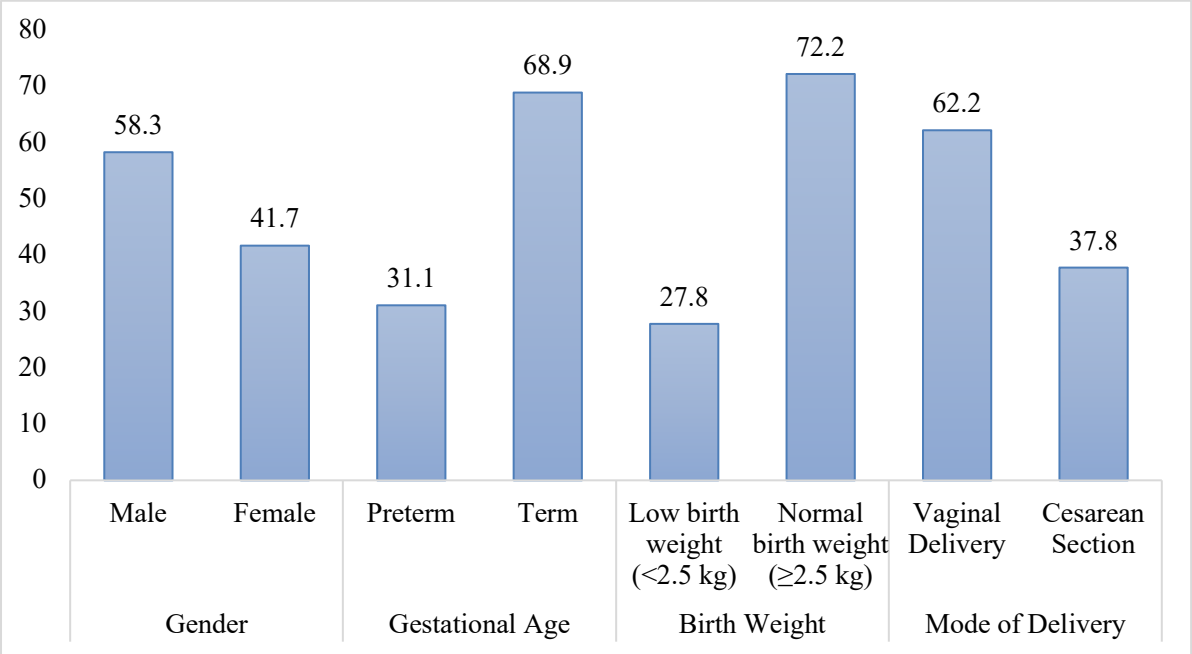

Figure 1: Visual Representation of Demographic and Neonatal Characteristics of Study Participants

The analysis indicated that the instances of neonatal jaundice cases where phototherapy was used were significantly higher among male neonates and term infants. Although majority of the neonates belonged to the category of having normal birth weight, many of them were low weight and preterm suggesting that low birth weight and preterm delivery could be considered as factors responsible for causing neonatal jaundice. Additionally, the high prevalence of vaginal deliveries among affected neonates could be related to the delivery pattern among the neonates involved in the study. Overall, it can be concluded that there is a necessity for proper management of neonatal jaundice regardless of whether it is term or preterm infants.

Table 2 shows that respiratory failure, respiratory depression and apnea were the most important neonatal jaundice risk factors requiring phototherapy. The most frequent risk factors seen were prematurity and low birth weight, both occurring in 56 neonates (31.1%) and 50 neonates (27.8%), respectively. Forty neonates (22.2%) had poor feeding behavior; they were all breastfed. Other risk factors that were observed were ABO incompatibility (34 neonates – 18.9%) and sepsis (27 neonates – 15%). Eleven (6.1%), 14 (7.8%), and 19 (10.6%) neonates developed cephalhematoma, birth asphyxia, and Rh incompatibility, respectively.

Table 2: Risk Factors Associated with Neonatal Jaundice Requiring Phototherapy

Risk Factor	Frequency (n)	Percentage (%)
Prematurity	56	31.1
Low birth weight	50	27.8
Exclusive breastfeeding with poor feeding	40	22.2
ABO incompatibility	34	18.9
Sepsis	27	15.0
Rh incompatibility	19	10.6
Birth asphyxia	14	7.8
Cephalhematoma	11	6.1
Total	180	100

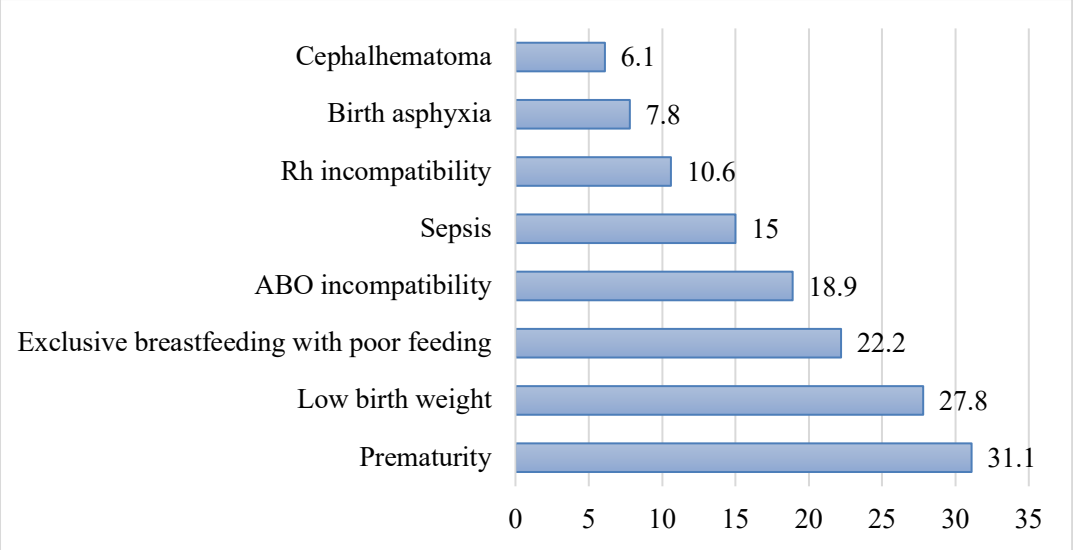

Figure 2: Visual Representation of Risk Factors Associated with Neonatal Jaundice Requiring Phototherapy

The results show that prematurity and low birth weight were major risk factors associated with the need for phototherapy in infants, which suggests that immaturity of hepatic functions and metabolism of bilirubin contribute to the rise of hyperbilirubinemia. Feeding problems such as exclusive breastfeeding with poor feeding due to, presumably, dehydration and decreased excretion of bilirubin, were factors that were associated with increasing the onset of jaundice. Blood incompatibilities, ABO and Rh incompatibilities, were the leading hemolytic factors, which have caused extremely high levels of bilirubin concentrations. Other factors such as sepsis, birth asphyxia, cephalhematoma have contributed to rising the incident rate and severity of neonatal jaundice.

Table 3 is a description of lab investigations and diagnosis in the 180 neonates who had hyperbilirubinemia requiring phototherapy. Of these 180 neonates 72 of them, the most common lab abnormality (40%) was high serum bilirubin concentration above the therapeutic level. Raised C reactive protein, indicative of infection or inflammation, in 30 infants (16.7%). Increased reticulocyte count indicative of hemolysis in 25 infants (13.9%). Raised serum bilirubin in 22 infants (12.2%) showing a positive direct Coombs test was an indication of immune hemolysis. Raised liver function tests were observed in 13 infants (7.2%). Increased reticulocyte count in 18 babies showed blood culture positive (10%).

Table 3: Laboratory and Diagnostic Findings

Investigation	Abnormal Findings (n)	Percentage (%)
Serum bilirubin above treatment threshold	72	40.0
Elevated C-reactive protein	30	16.7
Elevated reticulocyte count	25	13.9
Positive direct Coombs test	22	12.2
Blood culture positive	18	10.0
Abnormal liver function test	13	7.2
Total	180	100

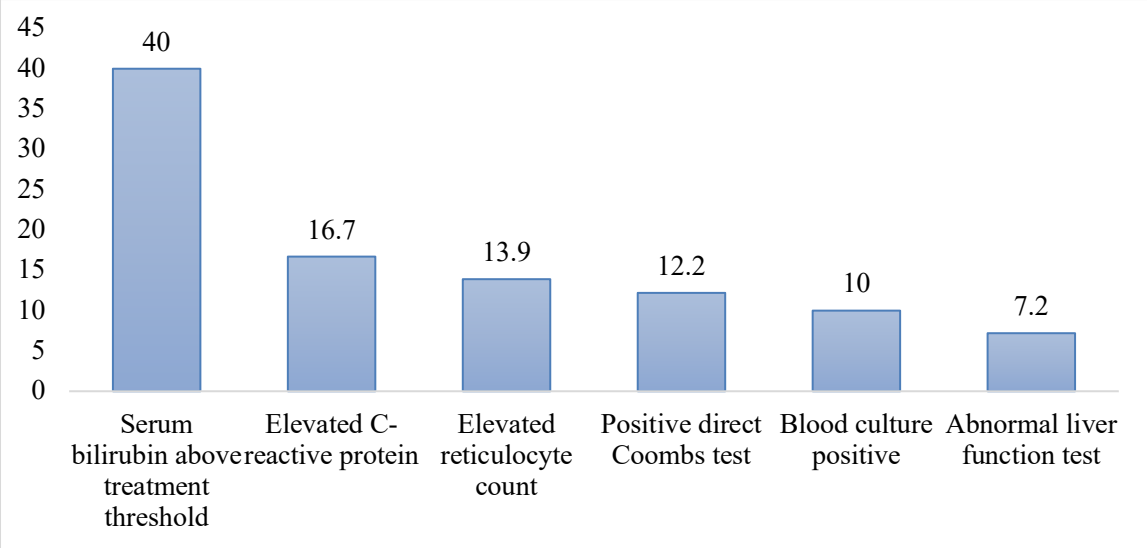

Figure 3: Visual Representation of Laboratory and Diagnostic Findings

These laboratory findings indicates that hyperbilirubinemia in management of neonatal jaundice by phototherapy, was the commonest abnormality seen in this study. Elevated reticulocyte counts and direct Coombs positive may indicate the causes were due to hemolytic process of blood incompatibility, in large proportion of neonates. Blood culture and elevated CRP may indicate infections and septicemia as causes in neonates. Neonatal abnormalities of liver function may exist which can either be immature hepatic function or hepatic dysfunction. From these findings it could be concluded that a thorough investigation has to be made on the cause and extent of neonatal jaundice.

In table 4 are shows the treatment schedules and outcomes in 180 neonates with neonatal jaundice that were submitted to phototherapy. Standard phototherapy was the most frequent treatment, and was used on 130 neonates (72.2%). Intensive phototherapy, which was used in cases of higher bilirubin values and severity of neonatal jaundice, was administrated in 20 neonates (11.1%). Exchange transfusion was used only in the treatment resistant to phototherapy or to cases of hyperbilirubinemia and severe jaundice, in 6 neonates (3.3%). 4 neonates (2.2%) died, and 2 neonates (1.1%) developed bilirubin encephalopathy.

Table 4: Treatment Modalities and Clinical Outcomes

Treatment/Outcome	Frequency (n)	Percentage (%)
Conventional phototherapy	130	72.2
Intensive phototherapy	20	11.1
Exchange transfusion required	6	3.3
Bilirubin encephalopathy	2	1.1
Mortality	4	2.2
Improved without complications	18	10.0
Total	180	100

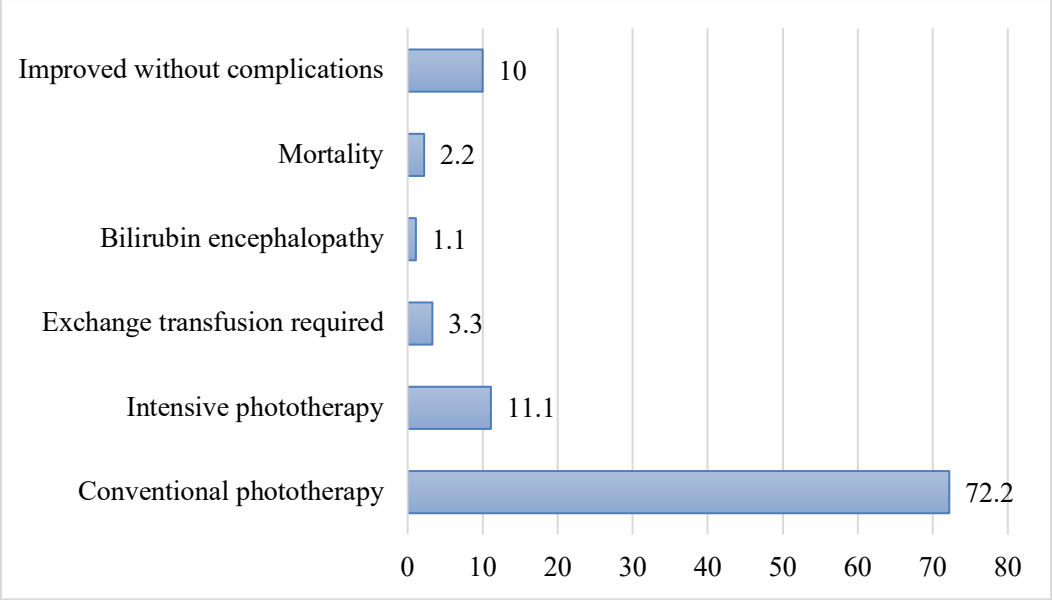

Figure 4: Visual Representation of Treatment Modalities and Clinical Outcomes

The findings indicate that infants with jaundice are mostly positively affected by standard PT. They reaffirm that standard PT is the first line in treating neonatal hyperbilirubinemia. The infants chosen to be studied had very high levels of jaundice (fewer infants received exchange transfusions & intensive PT). The early identification and treatment of neonatal jaundice are responsible for the low incidence of bilirubin encephalopathy and death in those who have this condition. A large percentage of neonates did improve with positive outcomes.

Discussion

The incidence and risk factors of phototherapy treatment of neonatal jaundice in neonates who were admitted to a tertiary care teaching hospital were assessed through a retrospective study (Woodgate & Jardine, 2011) [16]. The results indicated that males, full-term infants, and those who were delivered vaginally were much more likely to receive phototherapy for neonatal jaundice. This finding agrees with similar findings from prior studies of neonates showing that the male gender is an important risk factor for development of neonatal hyperbilirubinemia (a result of increased bilirubin production and immature liver function). While the majority of participants in this current study were considered full term and appropriate for gestational age, there were a significant number of premature infants and low birth weight infants that were affected severely by phototherapy for neonatal jaundice (Woodgate & Jardine, 2015) [17].

Another finding of this study was that the primary risk factors for the development of neonatal jaundice needing phototherapy are premature delivery, low birth weight, exclusive breast feeding with poor feeding patterns, incompatible (ABO) blood, and sepsis. Prematurity and low birth weight both indicate that the infant has a level of physiological immaturity that has a high impact on bilirubin metabolism. Issues associated with exclusive breast feeding and poor feeding patterns may result in dehydration and/or delayed clearance of bilirubin; therefore, elevated levels of serum bilirubin (Xiong, Qu, Cambier, & Mu, 2011) [18]. Hemolytic processes involving ABO and Rh incompatibility were also recognized as major contributing factors to the development of neonatal jaundice. Immune-mediated hemolysis increases the rate of destruction of red blood cells and increases the amount of bilirubin produced. The effect of neonatal infections and sepsis also worsens the severity of hyperbilirubinemia by interfering with bilirubin metabolism within the liver and creating additional metabolic stress.

The assessment of the treatment outcomes indicates that phototherapy, specifically conventional, is an effective treatment for neonatal hyperbilirubinemia (Yurdakök, 2015) [19]. Conventional phototherapy is effective for most neonates with some needing to receive intensive phototherapy or an exchange transfusion. The study showed that if neonates have their bilirubin levels diagnosed early and if there is prompt monitoring of bilirubin levels followed by prompt treatment intervention, most cases of neonatal hyperbilirubinemia will be managed successfully as indicated by the low incidences of bilirubin encephalopathy and death in the subjects of this study. This study concludes that early identification of risk factors and appropriate management of neonatal hyperbilirubinemia using phototherapy will significantly reduce morbidity of the neonate from hyperbilirubinemia (Zabeen et al., 2010) [20].

Conclusion

The study results obtained in this study reveal that neonatal hyperbilirubinemia with need for phototherapy treatment is a common health problem in the neonates, especially in those neonates who are either prematurely born or having low body weight, difficulty in breastfeeding, incompatible blood groups, and infections. There was more prevalence of medical hyperbilirubinemia among male neonates and preterm births. Presence of hemolysis and infections were some of the significant laboratory findings apart from high levels of serum bilirubin which had association with higher disease severity. Traditional phototherapy technique had revealed to be the most effective and commonly utilized mode of treatment, where there was significant improvement in terms of health of neonates. Early detection and prompt management of hyperbilirubinemia by routine checkups on bilirubin levels have been shown to be effective, owing to minimal mortality rate observed and low incidences of any serious complications such as bilirubin encephalopathy. It should be noted that due consideration is required to conduct screening and follow up of high-risk neonates in order to avoid neonatal morbidity.

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