# Continous And Intermittent Phototherapy In The Management Of Neonatal Hyperbilirubinemia A Randomised Intervention Study.

**by**

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**Dissertation submitted to**

**In partial fulfillment for the degree of**

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**IN**
**PEDIATRICS**

**Under the Guidance of**

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**Dr.**

## LIST OF ABBREVIATIONS

**TSB: Total Serum Bilirubin**

**RBC: Red Blood Cell**

**HO: Heme Oxygenase**

**UDPGT: Uridyldiphosphate Glucuronyl Transferase**

**CB: Conjugated Bilirubin**

**UB: Unconjugated (Indirect) Bilirubin**

**NH: Neonatal Hyperbilirubinemia**

**AAP: American Academy of Paediatrics**

**BBB: Blood Brain Barrier**

**ET: Exchange transfusion**

**LED: Light Emitting Diode**

**GDG: Guideline Developmental Programme**

**CPT: Continuous Phototherapy**

**IPT: Intermittent Phototherapy**

**CRP: C-Reactive Protein**

**KMC: Kangaroo Mother Care**

**Hr : Hour**

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## ABSTRACT

**BACKGROUND:**

Neonatal hyperbilirubinemia is a common and usually benign problem in neonates during the first week of life. Previous studies comparing intermittent versus continuous phototherapy for reducing neonatal hyperbilirubinemia have produced contradicting results.

**OBJECTIVES OF THE STUDY:**

To compare between intermittent and continuous phototherapy in reducing total serum bilirubin, rate of fall of bilirubin, duration of phototherapy and duration of hospitalisation in neonatal hyperbilirubinemia.

**MATERIALS AND METHODS:**

The study was a randomized interventional study done in neonates who got admitted in NICU who were >34 weeks, both genders, both normal and lower segment caesarean-section deliveries, birth weight ≥ 2000gm and APGAR score > 7/10 at 1 min were included in the study and randomised into group A (continuous phototherapy) & group B (intermittent phototherapy) based on treatment protocol. Rh incompatibility, ABO incompatibility, neonatal sepsis, any significant congenital malformation, Denial of consent were excluded from the study.

**RESULTS :**

In our study the mean serum bilirubin before the start of phototherapy was 15.64 ± 2.19 mg/dl for continuous and 15.03 ± 1.07 mg/dl for intermittent group, and the mean serum bilirubin at 12, 24, 48 hour was 13.26 ±2.4mg/dl, 10.8 ± 1.72 mg/dl, 10.16 ± 0.95mg/dl respectively for continuous and 12.6 ±1.65mg/dl, 10.04 ±1.8 mg/dl, 9.1 ± 0.66 mg/dl respectively for intermittent group, and mean rate of fall in serum bilirubin for continuous versus intermittent group was 0.22 ± 0.12mg/dl, 0.21 ± 0.08 respectively.

**CONCLUSION:**

Intermittent and continuous phototherapies were found to be equally effective. Because of the additional benefits of intermittent phototherapy, like nursing care of the baby, breast feeding, KMC care, building mother infant bonding, reducing work load on nurses , it can be followed as a routine method instead of continuous phototherapy in neonatal care units.

**KEYWORDS:**

Neonatal hyperbilirubinemia, Intermittent phototherapy, Continuous phototherapy.

# INTRODUCTION

Neonatal hyperbilirubinemia is a common and usually benign problem in neonates during the first week of life.[1] Most common cause of hyperbilirubinemia in neonates is physiological hyperbilirubinemia. About 97% of full term and preterm neonates demonstrate a biochemical hyperbilirubinemia (serum bilirubin >1mg/dl) and about 65% appear clinically jaundiced {Total Serum Bilirubin (TSB)>5mg/dl}.[2]

It is the most common cause of re-admission during the early neonatal period. American Academy of Paediatrics recommends that neonatal discharged within 48hrs should have a follow-up visit after 48 to 72 hrs for any significant jaundice and other problems.[3]

Clinical jaundice is seen in 60 -70% of term and about 80% of preterm newborns. Bilirubin production in neonates is 6-8mg/kg/day, which is 2 times more than its production rate in adults. Bilirubin is the final product of heme-protein metabolism and its raised levels are potentially neurotoxic.[4] Newborn infants with low levels of bilirubin glucuronosyl tranferase and genetic deficiency of this enzyme are at greater risk for developing bilirubin toxicity.[1]

The purpose of hyperbilirubinemia treatment is to prevent unconjugated bilirubin to reach neurotoxic level. Mainly two modes of treatment for hyperbilirubinemia, phototherapy and exchange transfusion.[4]

Phototherapy is the safe, effective and most widely used treatment for hyperbilirubinemia. Mechanism of action of phototherapy includes three mechanisms, of which

photoisomerisation which plays a major role by converting z isomer to e isomer. Structural isomerisation converts bilirubin to lumirubin and photooxidation plays minor role. Photoisomerisation of bilirubin occurs primarily in skin layers which is completed in nano seconds and the reformation of non-isomerised bilirubin collection in the skin takes 1 to 3 hr.[5]

The efficiency of phototherapy is related to the starting bilirubin concentration, efficiency will fall as the bilirubin decreases. It seems 1 to 3 hour period of phototherapy discounting, would make more intense bilirubin rebound into the skin and theoretically increases the effect of phototherapy. 1-3 hour of phototherapy discounting would make time for nursing care of the baby, feeding, kangaroo mother care, building mother and infant bonding, saves time and work load on nurses and also reduces the cost of phototherapy.[6]

Hence the present study is intended to compare between continuous and intermittent phototherapy in terms of rate of fall of bilirubin, decrease in total serum bilirubin, duration of phototherapy and hospitalisation which will be helpful in the management of hyperbilirubinemia and also in providing day care to the neonate.

# OBJECTIVES OF THE STUDY

1. To compare between intermittent and continuous phototherapy in reducing total serum bilirubin, rate of fall of bilirubin, duration of phototherapy and duration of hospitalisation in neonatal hyperbilirubinemia.
2. To study the secondary outcomes regarding cost effectiveness, availing free time for nurses, and parental satisfaction with care of neonate.

# REVIEW OF LITERATURE

Neonatal hyperbilirubinemia is the common cause of hospitalization in the 1st month of life.(7) A TSB level above 5mg/dl in neonates is the neonatal jaundice. In the 1st week of life around sixty percent of term and eighty percent of preterm babies develop jaundice, and at 1 month about ten percent of breastfed babies are still jaundiced and they are known to be associated with biochemical alterations.(8)

## BILIRUBIN

Bilirubin is the final breakdown product of hemoglobin and serves as a diagnostic marker of liver and blood disorder. Red blood cells (RBCs) only live for 90 days in the newborn period. Bilirubin is breakdown products of senescent RBCs in the reticuloendothelial system and then transported to liver for conjugation process and later excreted. Fault in synthesis, transport or breakdown of bilirubin may result in deposition of bilirubin in the skin and mucus membrane resulting in jaundice.(8) (9)

## BILIRUBIN CHEMISTRY

Bilirubin is made up of a 2 rigid, planar dipyrroles attached by a methylene bridge toform a tetrapyrrole. There are three isomers of bilirubin IIIα, IX α, and XIIα. Heme metabolism forms bilirubin IXα which is hydrophobic and virtually insoluble in plasma. 2 propionic acid sidechain in the bilirubin molecule makes it polar and water soluble. 6 hydrogen bonds stabilize Z-Z form of bilirubin and makes it insoluble. On exposure to light, Z-Z form is

transformed to E-E isomer, which do not allow for internal hydrogen bonding and makes it polar.Thus light exposed forms of bilirubin are more water soluble and easily excreted in the bile. This is the hypothesis for irradiating jaundiced neonate with 450nm light.[10]

**BILIRUBIN METABOLISM**

Bilirubin is the final product of heme metabolism. Haem is splitted specifically at the α-methene bridge by microsomal haemoxygenases, resulting in the formation of biliverdin and release of an iron molecule. The reaction consumes 3 molecules of $O_2$ and requires a reducing agent (NADPH). The α-methene-bridge carbon is removed as CO, and the Fe molecule is liberated. Subsequently, biliverdin reductase reduces biliverdin to bilirubin.[11]

Bilirubin is produced mainly from haem containing proteins from erythroid(old RBC's) and non-erythroid sources(cytochrome oxidase, catalase, and peroxidase), making 4mg/kg body weight of bilirubin. Approximately 20% of the total daily bilirubin production is normally donated by other haemoproteins, primarily in liver, such as and tryptophan pyrrolase. Bilirubin is potentially noxious but normally it remains non toxic by attachment to albumin and rapid conjugation and excretion by the liver.[11]

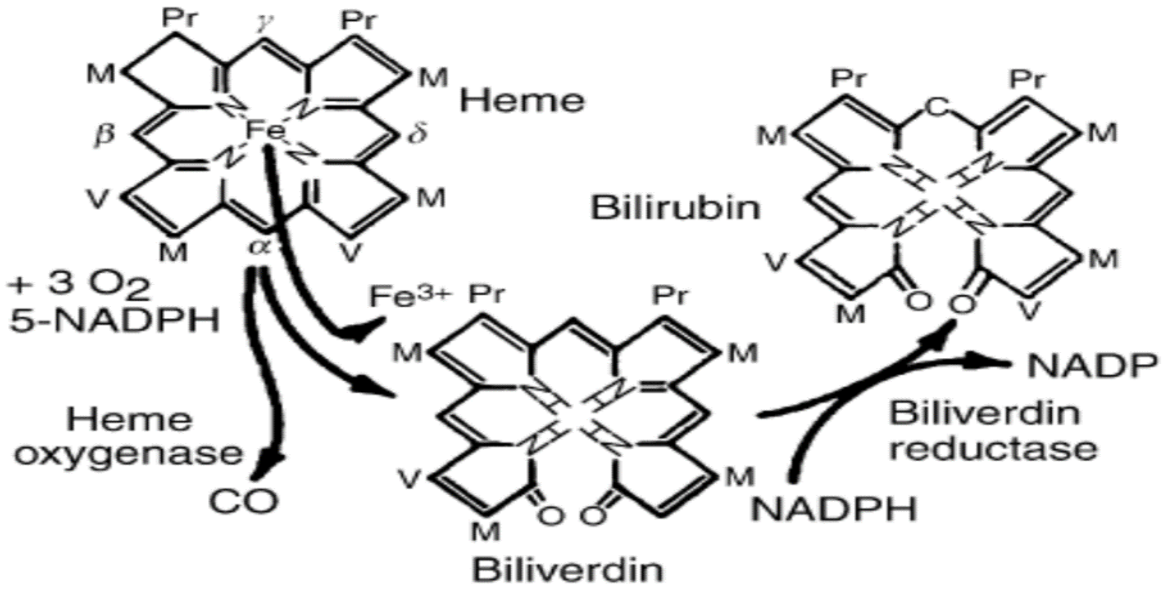



**Fig 1: Enzymatic mechanism of bilirubin formation.**[11]

Heme oxygenase is a membrane-associated enzyme;involved in heme catabolism.The 1st enzymatic step needs oxygen ($O_2$) and NADPH contributed from the cytochrome P450 system. It includes a chain of oxidation & reductions, finally leading to the cleavage of the α-methene bridge of the heme ring, liberating CO and Fe 2+ , producing the green pigment, biliverdin. In most mammals, biliverdin is quickly reduced in the cytosol by biliverdin reductase in the company of NADPH to generate the yellow pigment, bilirubin. It is normally conjugated & then excreted via the liver. It is carried in the bloodstream bound to albumin, and is actively transported across the sinusoidal cell membrane of hepatocytes facing the blood stream (space of Disse).Once within the hepatocytes, it is conjugated with glucuronic acid to form bilirubin glucuronide, also termed as "conjugated" or "direct" bilirubin.[12]

The conjugation of bilirubin occurs with the help of uridyldiphosphate glucuronyl transferase (UDPGT), which transfers a glucuronicacid molecule to form bilirubin diglucuronide; conjugated bilirubin (CB) & secreted from the hepatocyte into the bile caniliculi. Once in the hepatic duct, it mixes with secretions from the gallbladder through the cystic duct & is expelled through the common bile duct in to the intestines. Intestinal bacteria

act on CB to produce mesobilirubin, which is reduced to form mesobilirubinogen and then urobilinogen (a colorless product). Most of the urobilinogen produced (roughly 80%) is oxidized to an orange-coloured product called stercobilin and is eliminated in the feces. Stercobilin imparts brown colour to the stools. 20% of urobilinogen formed, is recycled to the liver by extrahepatic circulation and re- excreted. Remaining small quantity of bilirubin will enter systemic circulation and will subsequently filtered by kidney and excreted in the urine.[13]

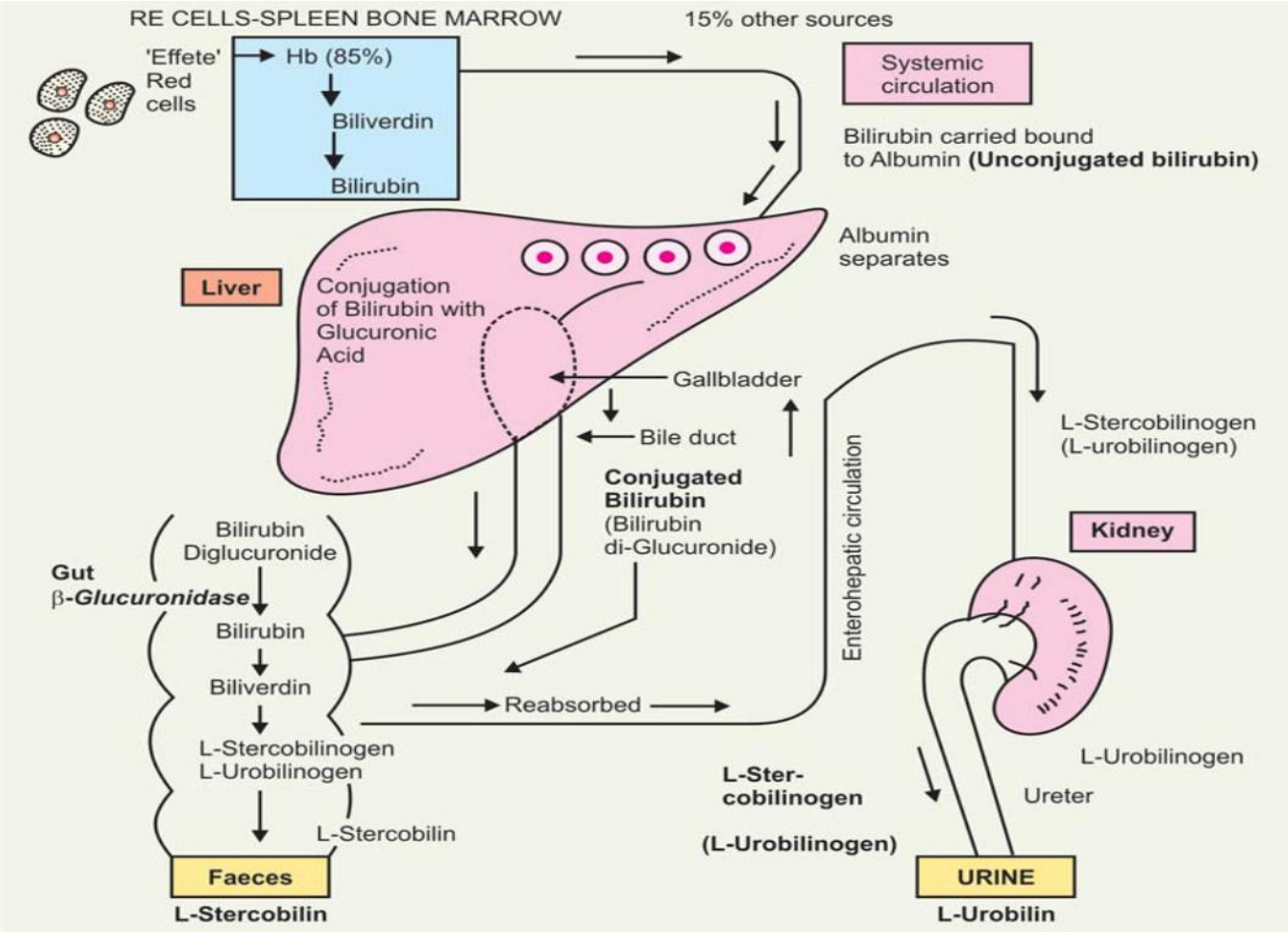



**Fig 2: Diagrammatic representation of bilirubin metabolism[10]**

**BILIRUBIN METABOLISM IN NEONATES**

Newborn infants, particularly premature ones, have an immature CB and excretion system, which results in neonatal jaundice with elevated levels of unconjugated (indirect) bilirubin (UB) levels.[10] They have high red cell mass at birth (due to relatively hypoxic environment), short red blood cell life span and increased enterohepatic circulation due to sterile gut.[14]

Normal infants after the age of 1 month, the processes of hepatic uptake, storage, conjugation & biliary secretion of bilirubin have matured to near adult levels so that the concentration of UB in plasma is<20μm (<1.2 mg/dl). In utero, the very limited excretory function of the fetal liver is compensated by active transport of UB across the placenta to the maternal circulation. At birth, the newborn is suddenly deprived of placental protection, just when a marked increase in catabolism of red cell hemoglobin to UB greatly increases the load of UB to the liver. Delayed maturation of hepatic transport processes results in significant retention of UB even in healthy term newborns. In addition newborn lacks anaerobic intestinal flora that convert UB to urobilinogens, leaving more unmetabolised UB free for absorption into the portal blood, thus increasing the entero-hepatic circulation of UB. Owing to the potent, antioxidant properties of unconjugated, the modest physiologic jaundice of the newborn is thought to be neuroprotective.[15]

Physiological jaundice is generally not harmful, but bilirubin levels above10mg/dl coupled with prematurity, low serum albumin, acidosis, & substances that compete for the binding sites of albumin (eg., ceftriaxone, sulfisoxazole, and aspirin)may increase the risk for kernicterus. Bilirubin concentrations reach a peak within 3 to 5 days of birth and remain elevated for <2 weeks. Bilirubin is usually less than 5mg/dl, with 90% unconjugated. Factors contributing to physiologic jaundice include are increased load in the newborn because the RBC'S have a shortened life span; the appearance of shunt bilirubin ,which is bilirubin derived from in-effective erythropoiesis or non RBC sources, decreased conjugation of bilirubin owing to a relative lack of glucuronyl transferase in the first few days following

birth, Increased absorption of bilirubin in the intestine owing to beta-glucuronidase in meconium, which hydrolyses bilirubin conjugates to UB that can be passively reabsorbed, and exposure of breast feeding infants to pregnanediol, nonesterified fatty acids, and other inhibitors of bilirubin conjugation present in the breast milk. Deficient UDPG-T activity that results bilirubin conjugation impairment has been considered as a major cause of physiologic jaundice. 1st 10 days of life the UDPG-T in full-term and pre-mature neonates is usually less than 1% of adult values. Early diagnosis of neonatal jaundice is still difficult, mainly due to early discharge from the hospital which may be associated with delay in diagnosis.(16)

**REFERENCE RANGE FOR NEONATAL TOTAL BILIRUBIN**

Birth-1 day - 1.0- 6.0 mg/dl

1-2 day - 6.0-7.5 mg/dl

2-5 day - 4.0-12 mg/dl

5days-1month -0.0-1.8 mg/dl(17)

**NEONATAL HYPERBILIRUBINEMIA (NH)**

It is a common clinical sign encountered in neonates and in most cases a benign problem. Hyperbilirubinemia indicates an elevated level of bilirubin in the circulation.(18) It is a frequently encountered problem in 60%-80% of newborns during the first week of life. About 5% develop pathological jaundice. Hyperbilirubinemia is the result of an imbalance between bilirubin synthesis and its elimination. Early neonatal jaundice is due to rise in UB. (19) In a proportion of infants, jaundice may become severe with a risk of neonatal morbidity & mortality. Those who survive may acquire long term neurodevelopmental sequelae on central nervous system.(19) It includes cerebral palsy, intellectual difficulties & sensory neural hearing loss, or gross developmental delays.(20) In neonatal life, there is an increased production of

UB, because of a shorter life span of the RBCs and a reduced hepatic clearance of UB leading to its blood retention.[21] UB levels in full term neonates decline to adult levels (1mg/dl) by 10-14 days of life. If persistent indirect hyperbilirubinemia for more than 2 weeks suggests hemolysis, breast milk jaundice, hypothyroidism,hereditary glucuronyl transferase deficiency, or intestinal obstruction.[22]

NH is a common worry for the parents as well as for the paediatricians. It is seen in five to ten percent of healthy term newborns and is the one of the frequent reason for readmission after early hospital discharge. TSB in newborns discharged within 48 hr of life generally shows an increasing trend and some of these neonates later develop hyperbilirubinemia. Previous study., found that hyperbilirubinemia (serum bilirubin 17mg/dl) occurred only after 72 hours of age. American Academy of Pediatrics (AAP) recommends that neonates discharged within 48 hours should have a follow-up visit after 2-3 days to identify significant jaundice. Newborns who are clinically jaundiced in the 1$^{st}$ few days are more liable to develop hyperbilirubinemia later.[23]

**CAUSES OF HYPERBILIRUBINEMIA IN NEWBORNS**

Maternal factors like blood type RH Or ABO incompatibility, breast feeding, drugs like diazepam, gestational diabetes and neonatal factors like birth trauma (cutaneous bruising, instrumented delivery, cephalohematoma), excessive weight loss after birth (dehydration or caloric deprivation), drugs (sulfisoxazole acetyl with erythromycin, chloramphenicol, ethyl succinate), poor feeding, infections (TORCH), polycythemia, prematurity & previous sibling with jaundice.[2] A variant glucuronosyl transferase activity (1A1) and imbalances in the organic anion transporter 2 gene increases the risk of hyperbilirubinemia. Major Risk factors for severe hyperbilirubinemia includes, Blood group incompatibility with positive direct coombs test, other hemolytic disease (G6PD), increased end-title CO concentration,

gestational age 35 to 36 week, previous sibling received phototherapy.[22] Other causes of neonatal hyperbilirubinemia may include hereditaryspherocytosis, haemoglobinopathies, galactosaemia, infection, Crigler-Najjar syndrome, Gilbert syndrome, Lucey-Driscoll syndrome.[24]

**JAUNDICE IN NEWBORN**

Jaundice is regarded as accumulation of the yellow orange pigment bilirubin in the skin, sclerae, and other tissues. Neonatal jaundice is usually a normal physiologic condition occurring during the temporary period after birth. Severe neonatal jaundice is considered to be pathophysiologic.[16] The yellow colour usually results from the accumulation of unconjugated, non-polar, lipid soluble bilirubin pigment in the skin. [22]

**PHYSIOLOGICAL JAUNDICE**

It usually appears after 24 hours of life, peaks between 3-5days in term and 5-7 days in pre-term and disappears by 2 weeks of life. The peak bilirubin is under 15mg/dl.[28] The level of UB in umbilical cord serum is 1-3mg/dl & increases at a rate of <5mg/dl/24hr;thus,jaundice becomes evident on the 2nd or 3rd day, usually peaking between the 2nd and 4th days at 5-6mg/dl and reducing to<2mg/dl between the 5th and 7th days after birth.[22]

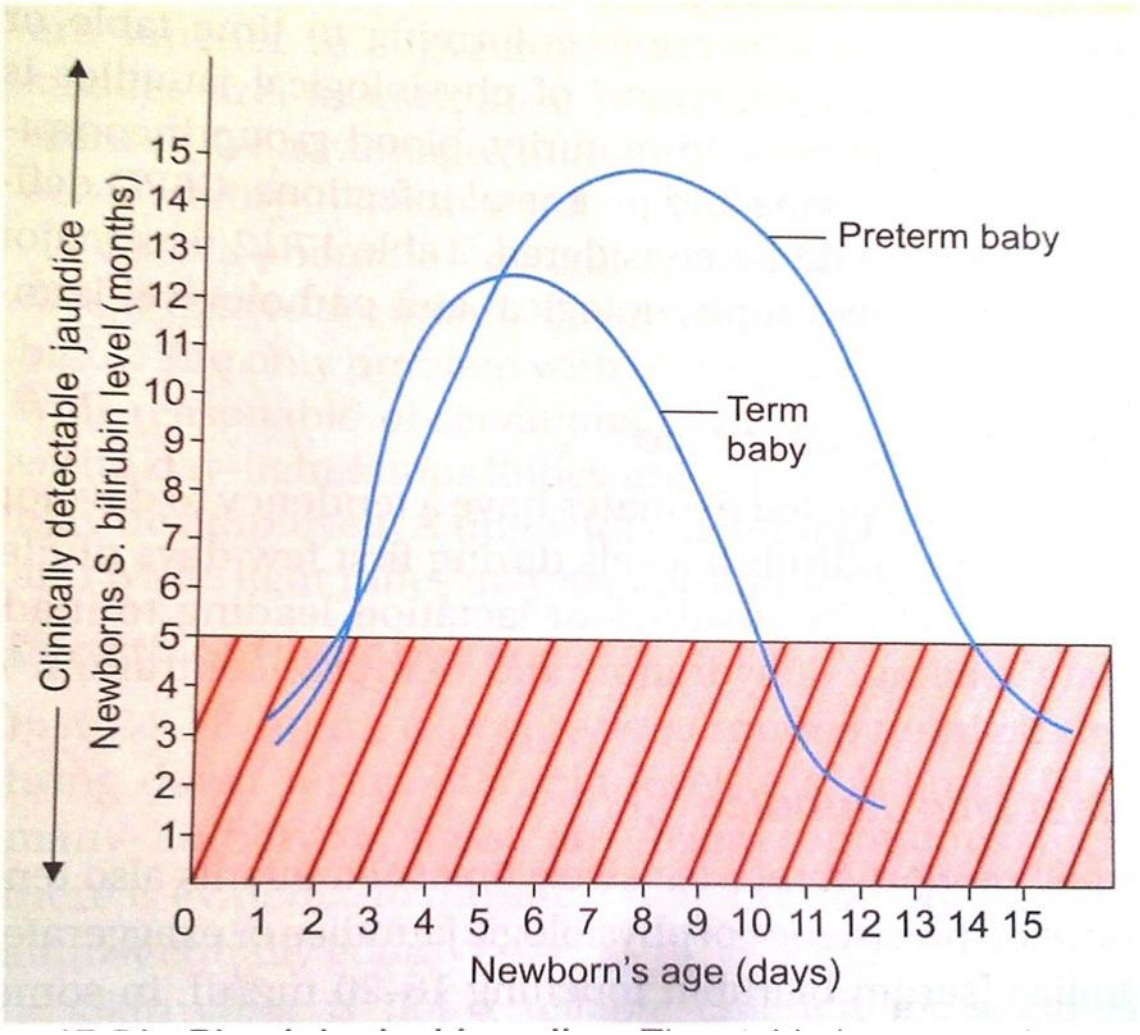



**Fig 3: Physiological jaundice in term and preterm neonates.**[22]

Visible jaundice usually appears between 24-72 hours of age. TSB level usually increases in full-term neonates to a peak of 6 to 8 mg/dl by 3 days of life and then decreases. A rise to 12mg/dl is in the physiologic range. In premature infants, the peak may be 10 to 12 mg/dl on the 5$^{th}$ day of life, possibly increasing more than 15 mg/dl lacking any specific abnormality of bilirubin metabolism. Levels less than 2mg/dl may not be seen until 1 month of life in both full term and pre-mature neonates. Safe bilirubin levels in pre-term differ according to gestational age. 6-7% of full term infants have UB levels>13mg/dl and less than 3% have levels>15mg/dl.[22]

## NON PHYSIOLOGIC JAUNDICE

Jaundice within 24 hours of life, peak bilirubin more than 15mg/dl and persistence beyond 2 weeks are not physiologic and needs to be investigated. Rate of increase of bilirubin greater than 0.5mg/dl/hr. or bilirubin level greater than 25mg/dl poses the risk of bilirubin toxicity in newborns. Bilirubin is a potential neurotoxin.[24] TSB concentrations have been defined as non-physiologic if concentration is more than 5 mg/dl on 1st day of life in term newborn, 10 mg/dl on 2nd day, or 12-13 subsequently. Any TSB level more than 17 mg/dl should be considered pathologic and warrants laboratory analysis for a cause and possible treatment, such as phototherapy. The pathological jaundice in 5-10% in healthy neonate is the usual cause for readmission of newborns in the first week of life.

## JAUNDICE ASSOCIATED WITH BREAST FEEDING

Increase in UB develops in an approximate 2% of breastfed term neonates after the 7th day, with maximal levels as high as 10-30mg/dl attained during the 2nd to 3rd week. If breastfeeding is sustained, the bilirubin slowly reduces but may persist for 3-10 week at lower levels. Kernicterus can occur in neonates with breast milk jaundice. The breast milk jaundice occurs because of the presence of glucuronidase in breast milk.[22]

## KERNICTERUS (Bilirubin Encephalopathy)

It is a neurological syndrome occurs due to deposition of unconjugated bilirubin in the basal ganglia and brainstem nuclei with evidence of neuronal injury. It involves an communication between UB levels, albumin binding and unbound bilirubin levels, channel across the blood brain barrier (BBB), & neuronal vulnerability to injury. It usually occurs in neonates with a bilirubin>20mg/dl. The more immature the neonate, greater the vulnerability to kernicterus. Due to hyperbilirubinemia the complications such as kernicterus, abnormal psychomotor and neurological sequelae usually occur. Early identification and adequate management to

prevent these complications are important.[25] Signs usually seen 2-5 days after birth in term newborns and as late as the 7thday in preterm newborns, but severe jaundice may lead to encephalopathy at any period during the neonatal life. Lethargy, loss of the moro reflex and poor feeding are initial signs. Infant who suffer looks severely ill & prostate, with decreased tendon reflexes and respiratory depression. In severe cases, convulsions & spasm occur, & stiffness extending their arms in an inward rotation with fists clenched.[22]

## MANAGEMENT OF JAUNDICE IN NEONATES

Diagnosis for jaundice 1st recognized after 1st week of life. It includes; Determination of CB & UB levels, haemoglobin, reticulocyte count, coombs test, blood grouping type, and testing of peripheral blood smear. Indirect hyperbilirubinemia, reticulocytosis and a smear with proof of RBC destruction suggest hemolysis.[22]

## SCREENING PROTOCOL FOR DETECTION OF JAUNDICE IN NEWBORNS

### Recommendations[26][27]

1. Hospital care stakeholders should all look for jaundice (visual inspection) in neonates **(Figure 4)**

2. Assessment of all neonates for hyperbilirubinemia should be done every 12 hours especially in the first 3 to 5 days.

3. Monitoring for development of severe newborn jaundice may be required till end of 1st week of post-natal life

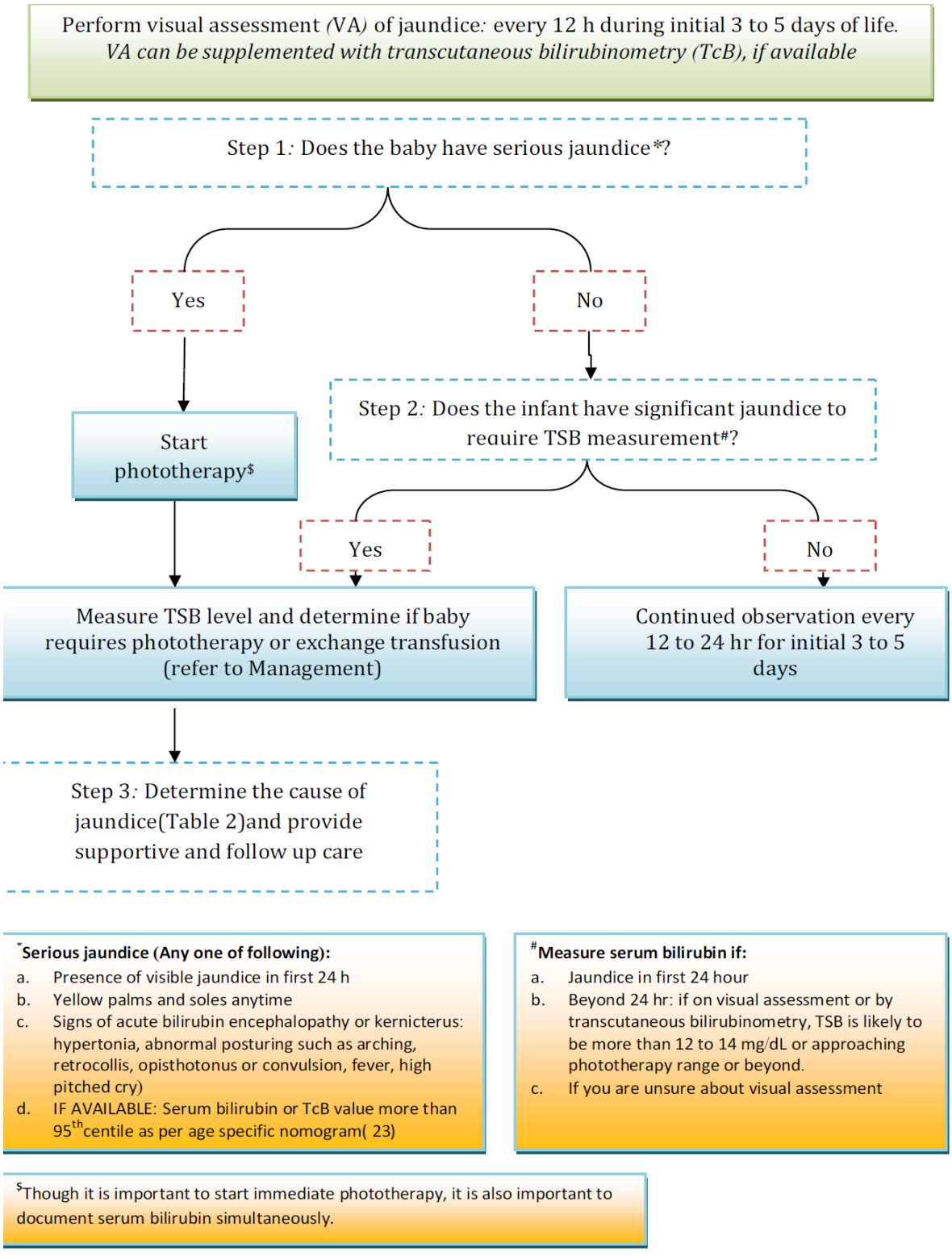



**Fig 4: Approach to an infant with jaundice[27]**

**The standard treatment for neonatal jaundice includes phototherapy and exchange transfusion and other treatment modalities are**

a) **Exchange transfusion (ET):** It is recommended for infants whose bilirubin level cross the threshold or those who have clinical features of kernicterus. But the procedure is invasive. [21]

b) **Intravenous immunoglobulin:** In newborns with isoimmune hemolytic disease, administration of specific intravenous immunoglobulin (0.5-1g/kg over 2-4h) reduces the level of bilirubin and the need for ET.[21]

c) **Metalloporphyrins:** One of the alternative therapy used for hyperbilirubinemia. Competitive enzymatic inhibition of the rate limiting conversion of heme protein to biliverdin by HO. A single intramuscular dose on the 1stday of life may reduce the need for subsequent phototherapy. The administration of Sn mesoporphyrin (SnMP) may reduce the bilirubin levels, requirement of phototherapy and length of hospital stay. [21]

d) **Phenobarbitone:** It is a potent inducer of uridine diphosphate glucuronosyl transferase. It has been used in prevention of neonatal jaundice for very low birth weight.[21] Which depends up on serum bilirubin levels.

The standard treatment for neonatal hyperbilirubinemia includes phototherapy and ET.

AAP criteria should be used in making decision regarding exchange transfusion or phototherapy in these infants. AAP provides 2 age-specific nomograms –

1. Phototherapy
2. Exchange transfusion.

The nomograms have lines for 3 different risk categories of neonates **(Figure 5 and 6).** Which includes:

1. Lower risk babies (38 wk or more and no risk factors),
2. Medium risk babies (38wk or more with risk factors, or 35 wk to 37 wk and without any risk factors) and
3. Higher risk (35 wk to 37 wk and with risk factors).[28]

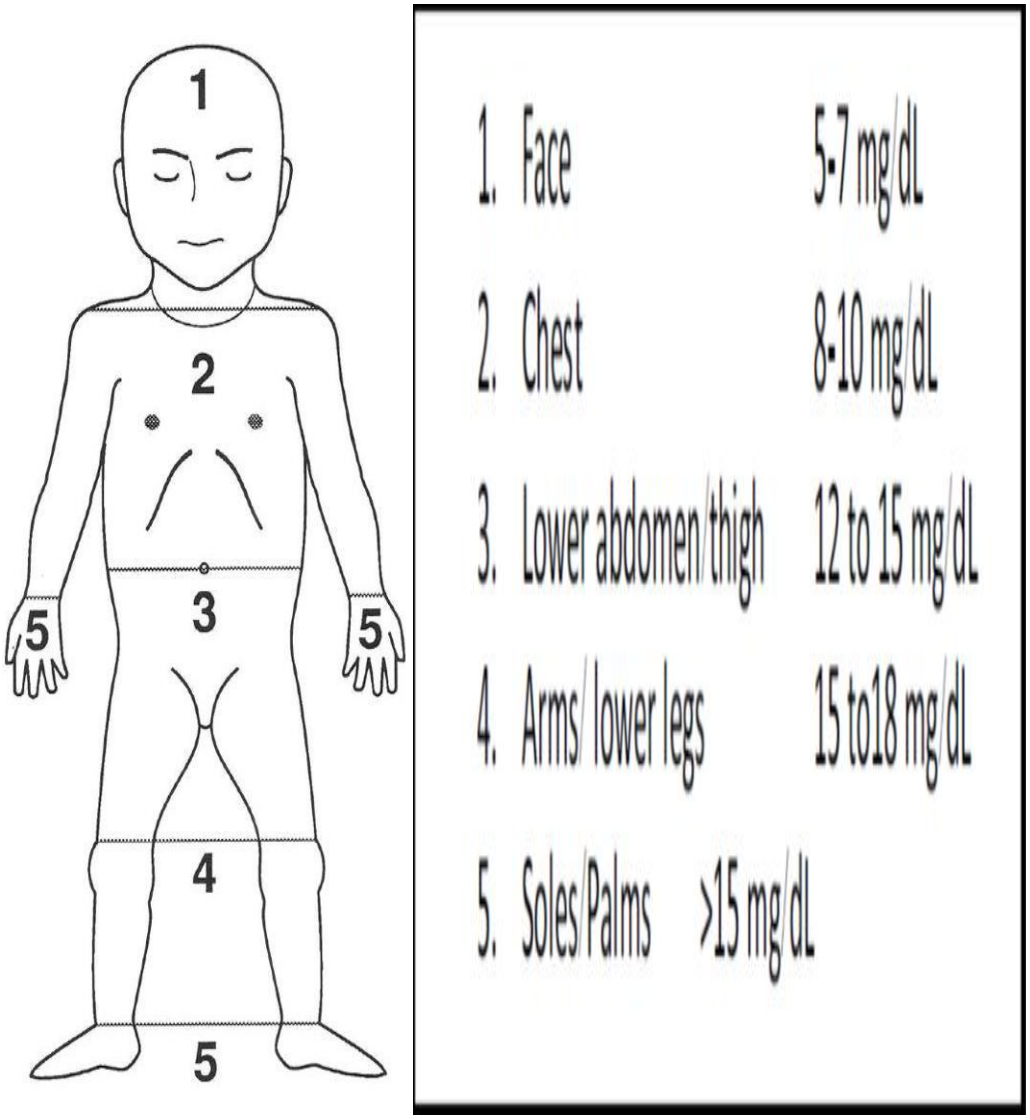



**Figure 5: The extent of jaundice (Kramer's rule)[29]**

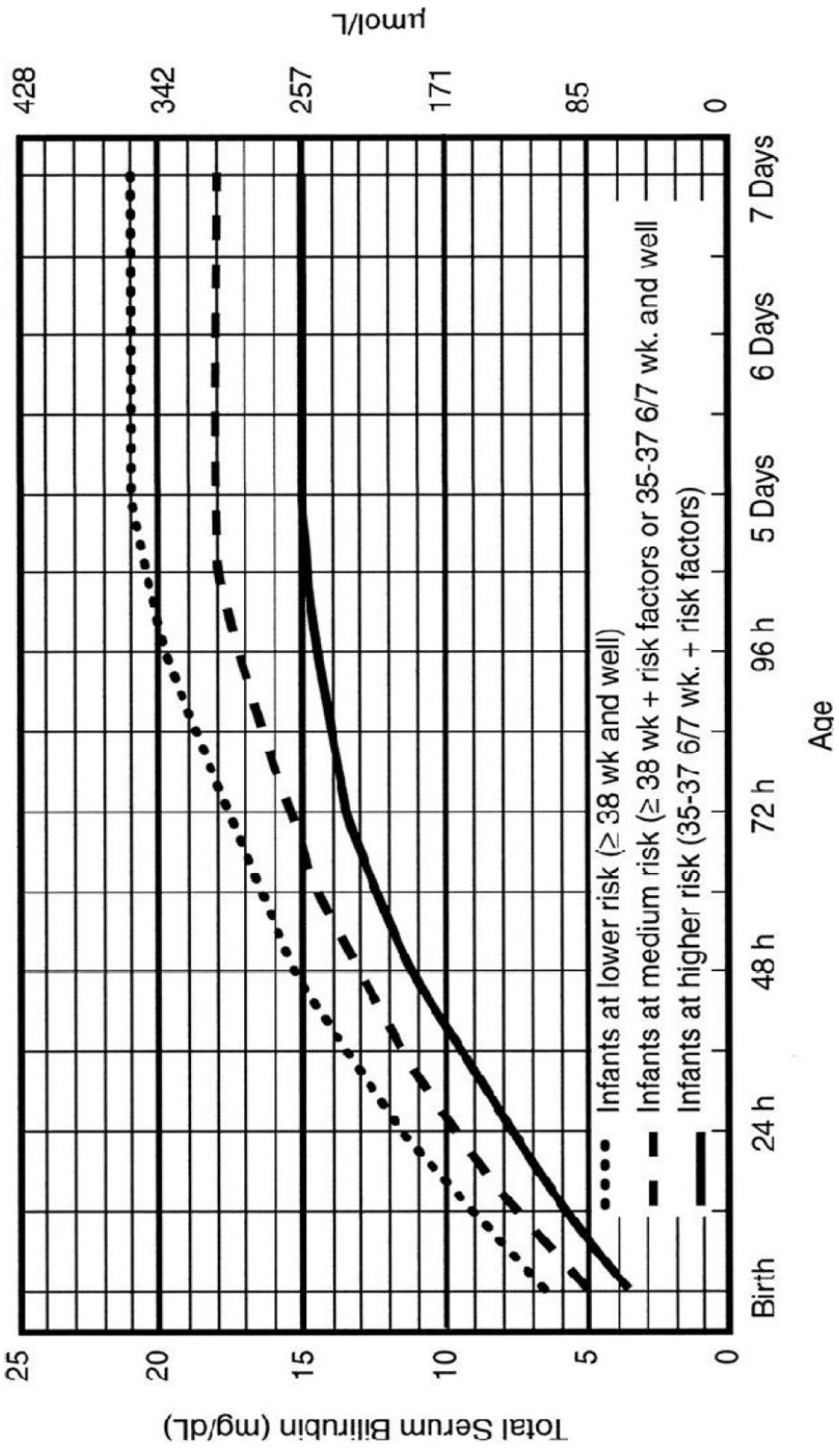



**Figure 6: Guidelines for phototherapy in hospitalized infants of 35 or more weeks gestation[28]**

Total serum bilirubin value is taken for judgment and direct portion should not be subtracted from it. The babies at lower & higher risk have their cut-offs at roughly 2 mg/dL higher or 2 mg/dL lower than that for medium risk babies, respectively. Risk factors take account of G6PD deficiency, hemolytic anemia, asphyxia, sepsis, temperature unstability, hypothermia, acidosis, severe lethargy, & hypoalbuminemia.[28]

Phototherapy can be given by light emitting diode (LED) or fibreoptic or fluorescent lamps or tubes or bulbs. Exposing the baby to sunlight does not help in treatment of jaundice and is involved with risk of sunburn so it should be avoided.(26)

**Starting phototherapy**

- Use serum bilirubin levels in deciding for initiating phototherapy.
- Intensive phototherapy must be ensured for newborns approaching exchange transfusion threshold. Phototherapy can be increased by an additional light source or rising the irradiance of the previous light source used.
- Intensify the area of exposure to light by using double surface phototherapy for severe hyperbilirubinemia.
- It is important to carry out periodic checks of phototherapy units to make sure that a required irradiance is being delivered.
- Phototherapy thresholds presented on $7^{th}$ day may be used for rest of the neonatal period.

**Stopping phototherapy**

- For neonates who are readmitted after their birth in hospital (for TSB levels of 18 mg/dL or higher), phototherapy can be discontinued when the serum TSB level falls less than 13 to 14 mg/dL.

**Discharge and follow up after phototherapy**

- If phototherapy is used for newborn with hemolytic diseases or is started early and discontinued before the newborn is 3 to 4 days old, a follow-up bilirubin measurement within 24 hours after discharge is advised.
- For newborn who are readmitted with jaundice and then discharged, significant recurrence is rare, but a repeat Total serum blilirubin measurement or clinical follow-up 24 hours after discharge is advised.
- Assessing serum bilirubin 24 h after discharge to look for recurrence is not obligatory.[26]

## PHOTOTHERAPY AND SERUM BILIRUBIN LEVELS

The effect of phototherapy is usually calculated in decrease of TSB level which depends on the rates of production as well as clearance of the photoproducts. If phototherapy is started in the 1$^{st}$, 3-4 days of life when TSB levels would normally be expected to raise, an absolute reduction of TSB levels may not be achieved. If phototherapy is initiated after this period, effective phototherapy produce a measurable decrease of STB within 4-6 hours, and a reduction in TSB levels of 40-50% in 24 hours can be achieved. In newborns who receive phototherapy, photoisomer formation starts almost as soon as phototherapy is initiated, and long before significant changes in TSB can be detected.[30]

## PHOTOTHERAPY AND BILIRUBIN TOXICITY

Increase in serum Z,E-bilirubin earlier than then the other isomers, it is more slowly cleared. After 2 h of phototherapy TSB is only minimally decreased, while significant production of the Z,E photoisomer is noticeable within 15 min, However even in the same TSB levels, risk of bilirubin encephalopathy is lower in infants who receive phototherapy, and photoisomer production might be directly neuro-protective, irrespective of the effect on excretion.[31][32]

## CONVENTIONAL PHOTOTHERAPY

Aids used for conventional phototherapy are fluorescent lamps, halide gas discharge tubes, tungsten halogen bulbs, or LEDs. Fluorescent tubes are the most common type of light source used as they are less expensive but their intensity of light and irradiance decreases with time and needs to be changed after every 1,000-1,500 hours. Nowadays LED phototherapy is the most commonly preferred in neonatal units.[33]

A LED is a light source, belongs to class of semiconductor diode when connected to an electrical circuit emits light. The light produced is of special blue narrower spectrum, and the colour depends on the semiconductor used. Such light sources emit high-intensity light with less heat generation, and can be kept nearer to the infant, increasing spectral irradiance. It might be clinically more effective than conventional phototherapy with blue-white or green fluorescent tubes as judged by the production of lumirubin in vitro studies.[33]

## FIBEROPTIC PHOTOTHERAPY

Fiberoptic phototherapy, a new aid using optical fibers, has been reported to be effective in decreasing TSB for newborn with hyperbilirubinemia. These aids use a standard light source, usually a quartz halogen bulb. Although fiberoptic phototherapy is equally as effective as conventional phototherapy in preterm babies, these devices are less effective in reducing the TSB level than the conventional phototherapy. Combination of a conventional phototherapy and fiberoptic device is more effective than conventional phototherapy alone.[34]

## DOUBLE OR TRIPLE PHOTOTHERAPY

Despite significantly higher irradiance in the double (fiberoptic plus conventional, or both conventional) or triple phototherapy, there is no significant variation in the treatment. Although TSB values decreases significantly more slowly in infants who received single phototherapy than the double or triple phototherapy, the actual difference in 0-4 h decrease is

small.[35] More studies are needed to evaluate the double or triple phototherapy with high-energy phototherapy units.

## SUPER (HIGH-INTENSITY) PHOTOTHERAPY

Recently, significantly higher TSB decline rates were reported in neonates treated with the super (high-intensity). However, someother study shows that the rate and level of photo-isomerisation is not influenced by light source & irradiance.[36]

## DISTANCE OF THE LIGHT SOURCE

As the spacing between the light source and baby increases,the irradiance decreases. The space from the light source to the newborns is 40 to 50 cm because the heat production from the fluorescent tubes risked overheating the newborn at short distance. For LED lights minimum 20 cm is maintained between baby and light source.[37]

## OVERHEAD VERSUS UNDERNEATH PHOTOTHERAPY

By using a planar (horizontally flat) overhead phototherapy unit up to 1/3$^{rd}$ of a baby's skin surface area is illuminated. For the treatment of neonatal hyperbilirubinemia, commercially available LED devices provide light from either above or underneath the baby. Probably overhead is preferred to underneath LED phototherapy in the management of newborn jaundice because of the more body surface exposed to light.[38]

## CONTINUOUS AND INTERMITTENT PHOTOTHERAPY

Intermittent phototherapy (on for 1 hour then off 1 hour; 12 hours on, 12 hours off; 1 hour on, 3 hours off) is as effective as the continuous phototherapy.[39][40]

## "CONTINUOUS AND INTERMITTENT PHOTOTHERAPY IN THE MANAGEMENT OF NEONATAL HYPERBILIRUBINEMIA"

Phototherapy used to be safe according to the experience by its usage in developed countries and shortage of reported serious long-run adverse effects of short term phototherapy so far.[41][42] The previous report from combined studies on the effectiveness and safety of phototherapy, undertaken under the auspices of the National Institute of Child Health and Human Development, showed, newborns receiving phototherapy necessitate significantly less exchange transfusions. Furthermore, future follow-up studies showed no adverse outcome in the newborns who received phototherapy in the newborn period.[43]

Phototherapy is useful both as therapy or as prophylaxis. 2 different mechanisms have been explained in reducing TSB levels in neonates receiving phototherapy;

1. Photoisomerization
2. Photooxidation.

In comparison with photoisomerization pathway, the oxidation mechanism appears to play a very minor role in breakdown of UB in vivo. Previous clinical studies comparing intermittent versus continuous phototherapy have produced contradicting results. Several studies were unsuccessful to show effectiveness of the intermittent therapy. These outcomr may have resulted from prolonged light-on and light-off schedule, for example 6-12 hour on-off cycle.[44] Photoisomerization of bilirubin occurs primarily in skin layers and the reaccumulation of the bilirubin in the skin takes roughly 1 to 3 hours. Thus a prolonged on-off schedule may not be as effective as continuous therapy, but an on-off cycle of <1 hour is apparently as effective as continuous therapy. Phototherapy lights should be kept off and eye patches removed during feeding & family visiting for up to 1 hour; this will not significantly decrease phototherapy effectiveness.[28]

Previous studies comparing intermittent versus continuous phototherapy have observed contradicting results.[45] As light exposure increases bilirubin excretion (compared with darkness), no scientific rationale exists for using intermittent phototherapy, and however, phototherapy need not to be continuous. Phototherapy may be discontinued during breast feeding or brief parental visits. If the infant's bilirubin level is nearing the exchange transfusion zone, phototherapy should be provided continuously until a satisfactory decrease in the serum bilirubin level occurs or exchange transfusion is initiated.[46]

Two previous studies(N = 110)[46][47] contributed for estimating each comparing continuous phototherapy to different intermittent regimens. These two randomized control trail, 1 in term babies and other in pre-term babies, examined continuous phototherapy versus intermittent phototherapy with phototherapy being initiated at low TSB levels. No significant difference was found. No studies have examined intermittent phototherapy at moderate or high levels of TSB, so there is no evidence on the effectiveness of intermittent phototherapy at moderate or high TSB levels. The guideline developmental programme (GDG) notes that there was no difference between continuous versus intermittent phototherapy on either the duration of phototherapy or the mean change in TSB levels when started at low TSB levels.[26]

Interrupting phototherapy at lower TSB levels is safe. The GDG supports interrupting phototherapy treatment for short time facilitate breastfeeding & cuddles. This may help to decrease parental anxiety & stress caused by phototherapy. The GDG notes that there is no evidence based to support the safe use of intermittent phototherapy at moderate or high levels of TSB.[26]

Previous studies correlating intermittent versus continuous phototherapy have produced different results. As exposure to light increases excretion of bilirubin, continuous phototherapy would be more effective than intermittent one. But, as the efficiency of phototherapy is mainly related to the initial TSB levels, efficiency will reduce as the bilirubin decrease. Restoration of bilirubin into the skin occurs due to disruption of phototherapy but a question that remains unanswered is whether or not this small increase in skin TSB levels might improve efficiency when light therapy is restarted.[40] In practice, however, short on-off schedule (<1hour) complicates nursing care & are probably more trouble than may are worth.[44] So phototherapy should be intermittent during feeding or brief parental visits. In practice, however, it is not uncommon that the infant does not tolerate phototherapy and parents interrupt it for long duration of time. [44][48]

In a previous study by Abdul-Kareem et al.,[40], showed that intermittent phototherapy defined as 1hour on and 1 hour off is as effective as continuous phototherapy defined as 2 hours on and 1/2 an hour off, in reducing TSB, as with realization that photoisomerization occurs within minutes and bilirubin slowly enters into the skin over hours, intermittent phototherapy regimens were hypothesizes to be effective and where tested, and as photoisomerization of bilirubin occurs primarily in the skin layers and reaccumulation of the bilirubin pool in the skin takes approximately 1-3 hours. Thus a longer on-off cycle may not be as effective as continuous therapy, but an on -off schedule of (<1hour hour) is apparently as effective as continuous treatment.[40]

In another study by Lau and fung.,[39] observed differences in TSB kinetics between continuous versus intermittent therapy was insignificant, furthermore the study shows that intermittent phototherapy doesn't elongate the duration of therapy as by previous study quoted.[45][47] Though it is simple in application, it is also economically feasible for developing countries where the need is more and resources are poor. Furthermore, this

protocol is less interruptive to the establishment of neonate maternal bonding & breast feeding because the neonates are not confined to the incubators during the whole course of treatment.[39]

Phototherapy used to be safe according to the experience by its usage in developed countries and shortage of reported serious long-run side effects of short term phototherapy so far.[49] Few side effects associated with phototherapy are: skin rash, retinal damage, high insensible losses, and hyperthermia.[50] Previous studies comparing intermittent versus continuous phototherapy have produced contradicting results. More studies were unsuccessful to show effectiveness of the intermittent therapy. These outcome may have received from prolonged light on & light- off cycles, for example 6-12 hour On-off schedules.[47]

Phototherapy has serious side effects and worry has also been raised on the lack of evidence of safety of phototherapy in the long term run. With optimisation of photo-therapy in which the duration of exposure of neonates to light can be decreased without bargaining the efficacy would certainly be advancement over the conventional method.[51] Keeping all these in view, the present study was undertaken.

To find out the optimal on-off schedule, we conducted a randomized intervention study that is continuous versus intermittent phototherapy in the management of neonatal hyperbilirubinemia.

# MATERIALS AND METHODS

## SOURCE OF DATA

It was randomized interventional study, neonates who got admitted in NICU of BLDEU Shri B.M. Patil Medical College, Hospital and Research Centre, Vijayapur, fulfilling the inclusion and exclusion criteria over a period of 18 months from November 1st 2017 to April 2019. The study was performed after getting approval from the institutional ethics committee.

## INCLUSION CRITERIA:

Neonates >34 weeks, both genders, both normal and lower segment caesarian-section deliveries, birth weight ≥ 2000gm and APGAR score > 7/10 at 1 min were included

## EXCLUSION CRITERIA:

1. Rh incompatibility.
2. ABO incompatibility.
3. Neonatal sepsis.
4. Any significant congenital malformation.
5. Denial of consent were excluded

**METHODS OF COLLECTION OF DATA:**

In this randomised interventional study, a sample of 190 healthy neonates >34 weeks who got admitted for hyperbilirubinemia in NICU of Shri B.M. Patil Medical College, Hospital and Research Centre with birth weight of $\geq$ 2000 gm were included.

The neonates on admission were randomized into Continuous phototherapy (CPT) Group A and Intermittent phototherapy (IPT) Group B using block randomisation[9] (block size 10) in which 190 subjects were equally grouped. CPT (group A) received phototherapy for 3 hour and 45 min off. IPT (Group B) received phototherapy for 3 hour and then 3 hour off. During the off period baby was given to the mother for feeding, KMC care. Total serum bilirubin level of neonates on admission i,e 0hr were recorded. Then phototherapy was initiated as per American Academy of Paediatrics 2004 guidelines[8]. Total serum bilirubin levels in both A and B group were compared after each 12hr, 24hr, 48hr, 72hr of commencing phototherapy. In both groups, phototherapy was given using a double surface phototherapy unit (Phoenix brilliance classic with 12 LED bulbs, LED intensity >45microwatt/cm2/nm, wave length 450-465nm). A distance of 30 -35 cm was maintained between the baby and bulb surface.

Babies who developed clinically significant jaundice, treatment and follow up were done as per NICU protocol.

All neonates included in this study were having the following details:

1. Detailed maternal history like age, parity, gestational age was noted.

2. Details of labour, mode of delivery was recorded.

3. Details of baby like: sex, date of birth, time of birth, Apgar scores was noted.

4. Thorough clinical examination of the neonates was done.

5. All investigations was done at the Clinical Biochemistry and Pathology department of Shri B.M Patil Medical College, Hospital and Research Center, Vijayapur

**SAMPLE SIZE:**

Considering the mean±SD of bilirubin of IPT group at admission and 72 th hr as 18.5±1.8mg/dl and 7.94±1.45mg/dl respectively5, with power of 95, and margin of error±5 a sample size of 95 group neonates was required, so the sample size was 190.

Statistical formula $n = \frac{(Z_\alpha + Z_\beta)^2 \times SD^2}{d^2}$

Zα = Z value at α level

Zβ= z value at β level

SD= common standard deviation

d= difference between two parameters

# STATISTICAL ANALYSIS

All statistical analyses were conducted by using Statistical Package for the Social Sciences (SPSS V.17.0). The categorical variables were expressed in terms of percentages and Chi-square test was used for the analysis of these variables. Continuous variables with normal distribution were analyzed by measures such as sample mean, standard deviation, and statistical significance was tested by Student's t test and non-parametric data by Mann-Whitney U test. Correlation among the biochemical parameters was analyzed by Karl Pearson's Correlation Analysis. **(*P* value of <0.05 was considered as significant)**

# RESULTS

The Current study results were represented in tables **(Table No: 1-16)** and figures **(Figure No: 6-18)**. 190 neonates who got admitted in NICU who were >34 weeks, both genders, both normal and lower segment caesarean-section deliveries, birth weight ≥ 2000gm and APGAR score > 7/10 at 1 min were included in the study over a period of 18 months from november 1st 2017 to april 2019.

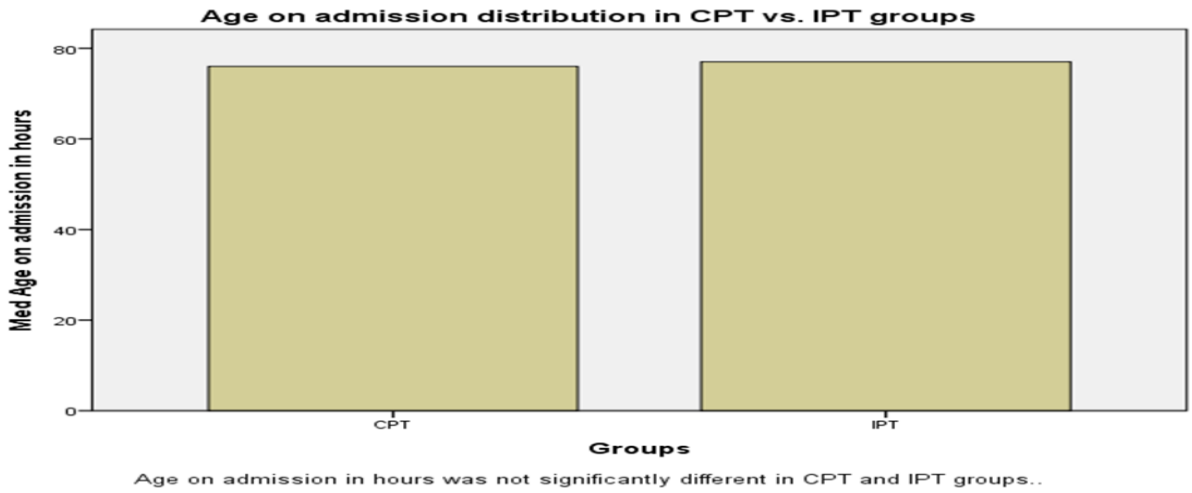
**Table no 1: Age on admission distribution in CPT vs. IPT groups**

| CPT | | IPT | | Z | p |
|---|---|---|---|---|---|
| Age on admission in hours: n-91 | | Age on admission in hours: n-98 | | | |
| **Median** | **IQR** | **Median** | **IQR** | | |
| 76 | 137 | 77 | 127 | -0.073 | 0.942 |

**Legend to table no 1:** Age on admission in hours was not significantly different in CPT and IPT groups. IQR-Inter quartile range; CPT-Continuous phototherapy; IPT-Intermittent phototherapy.

P<0.05 is significant. Mann Whitney U test was used to assess significance of difference between groups.

**Figure no 7: Age on admission distribution in CPT vs IPT groups**



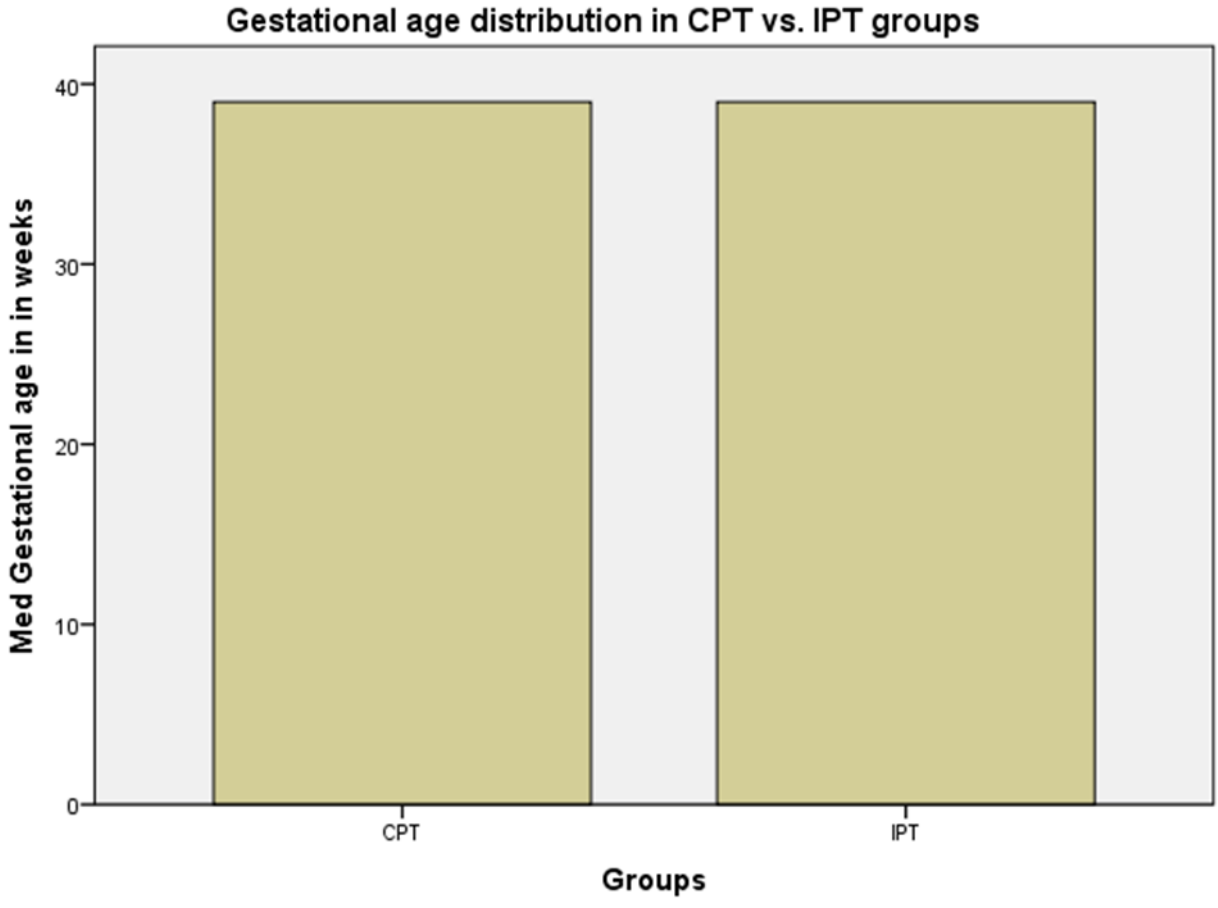
| Table no 2: Gestational age distribution in CPT vs IPT groups | | | | | |
|---|---|---|---|---|---|
| **CPT** | | **IPT** | | **Z** | **p** |
| **Gestational age in weeks : n-91** | | **Gestational age in weeks : n-98** | | | |
| **Median** | **IQR** | **Median** | **IQR** | | |
| 39 | 2 | 39 | 8 | -1.322 | 0.183 |

**Legend to table no 2:** Gestational age difference was not significantly different in CPT and IPT groups.

IQR-Inter quartile range; CPT-Continuous phototherapy; IPT-Intermittent phototherapy.

P<0.05 is significant. Mann Whitney U test was used to assess significance of difference between groups.

**Figure no 8: Gestational age distribution in CPT vs. IPT groups**




Gestational age difference was not significantly different in CPT and IPT groups.

| Table no 3: APGAR score at 1 min distribution in CPT vs. IPT groups | | | | | |
|---|---|---|---|---|---|
| **CPT** | | **IPT** | | **Z** | **p** |
| **n-91** | | **n-98** | | | |
| **Median** | **IQR** | **Median** | **IQR** | | |
| 7 | 0 | 7 | 7 | 0 | 1 |

**Legend to table no 3:** APGAR score at 1 min was not significantly different in CPT and IPT groups.

IQR-Inter quartile range; CPT-Continuous phototherapy; IPT-Intermittent phototherapy.

P<0.05 is significant. Mann Whitney U test was used to assess significance of difference between groups.

| Table no 4: APGAR score at 5 min distribution in CPT vs. IPT groups | | | | | |
|---|---|---|---|---|---|
| **CPT** | | **IPT** | | **Z** | **p** |
| **n-91** | | **n-98** | | | |
| **Median** | **IQR** | **Median** | **IQR** | | |
| 9 | 1 | 9 | 1 | -0.516 | 0.606 |

**Legend to table no 4:** APGAR score at 5 min was not significantly different in CPT and IPT groups.

IQR-Inter quartile range; CPT-Continuous phototherapy; IPT-Intermittent phototherapy.

P<0.05 is significant. Mann Whitney U test was used to assess significance of difference between groups.

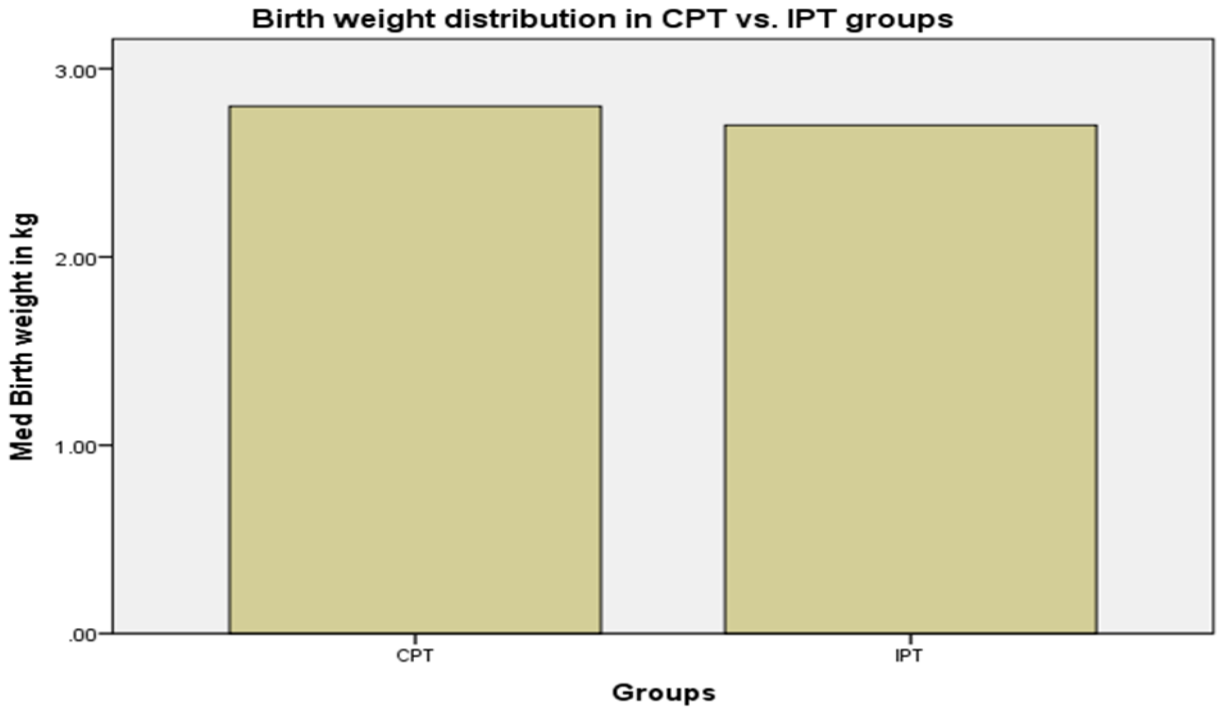
| Table no 5: Birth weight distribution in CPT vs. IPT groups | | | | | |
|---|---|---|---|---|---|
| **CPT** | | **IPT** | | **Z** | **p** |
| **Birth weight in kg : n-91** | | **Birth weight in kg : n-98** | | | |
| **Median** | **IQR** | **Median** | **IQR** | | |
| 2.58 | 0.8 (2.5-3.08) | 2.7 | 2(2.49-3.07) | -1.33 | 0.183 |

**Legend to table no 5:** Birth weight distribution in CPT vs. IPT groups was not significantly different in CPT and IPT groups.

IQR-Inter quartile range; CPT-Continuous phototherapy; IPT-Intermittent phototherapy.

P<0.05 is significant. Mann Whitney U test was used to assess significance of difference between groups.

**Figure No 9: Birth weight distribution in CPT vs. IPT groups**




Birth weight distribution in CPT vs. IPT groups was not significantly different in CPT and IPT groups

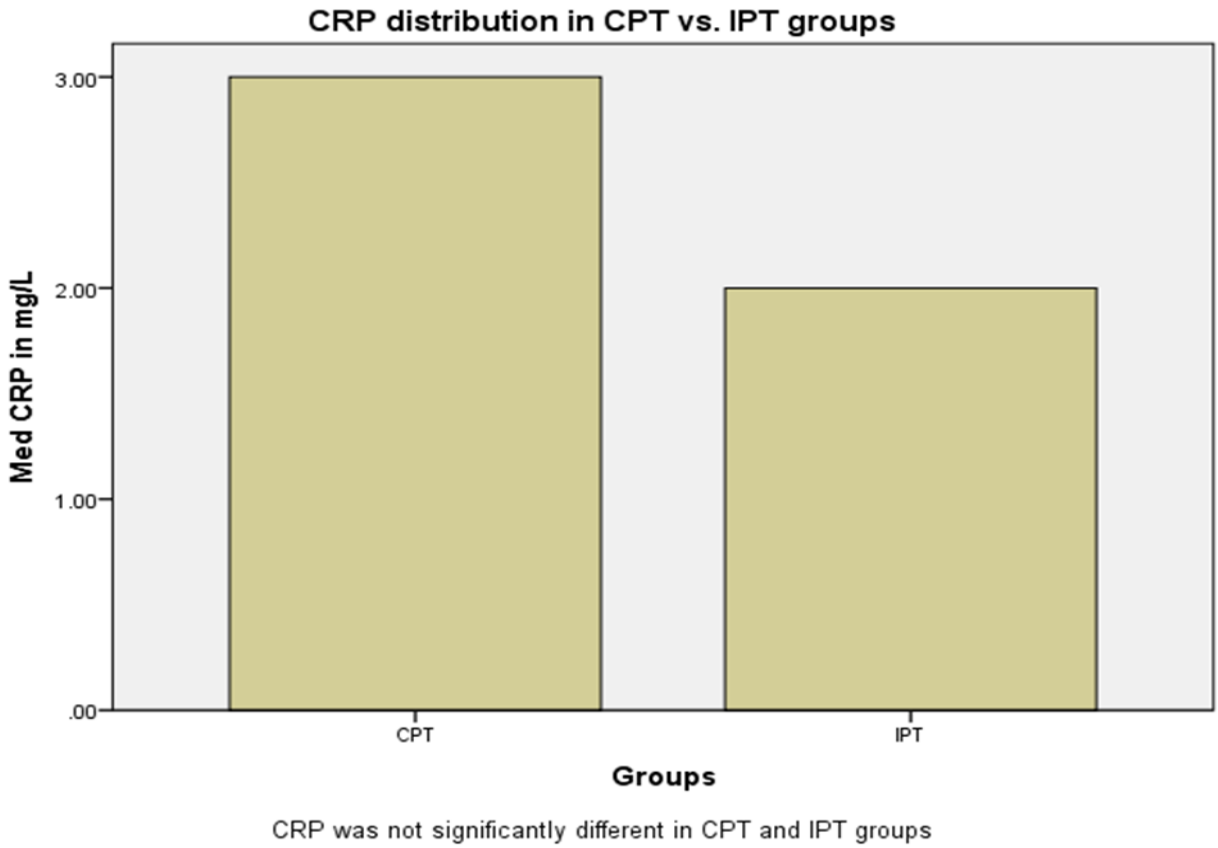
| Table No 6: CRP distribution in CPT vs. IPT groups | | | | | |
|---|---|---|---|---|---|
| **CPT** | | **IPT** | | **Z** | **p** |
| **CRP in mg/l : n-91** | | **CRP in mg/l : n-98** | | | |
| **Median** | **IQR** | **Median** | **IQR** | | |
| 3 | 8 (2-4) | 2 | 7(2-6) | -0.76 | 0.939 |

**Legend to table no 6:** CRP was not significantly different in CPT and IPT groups.

IQR-Inter quartile range; CPT-Continuous phototherapy; IPT-Intermittent phototherapy.

P<0.05 is significant. Mann Whitney U test was used to assess significance of difference between groups.

**Figure No. 10: CRP distribution in CPT vs. IPT groups**




CRP was not significantly different in CPT and IPT groups

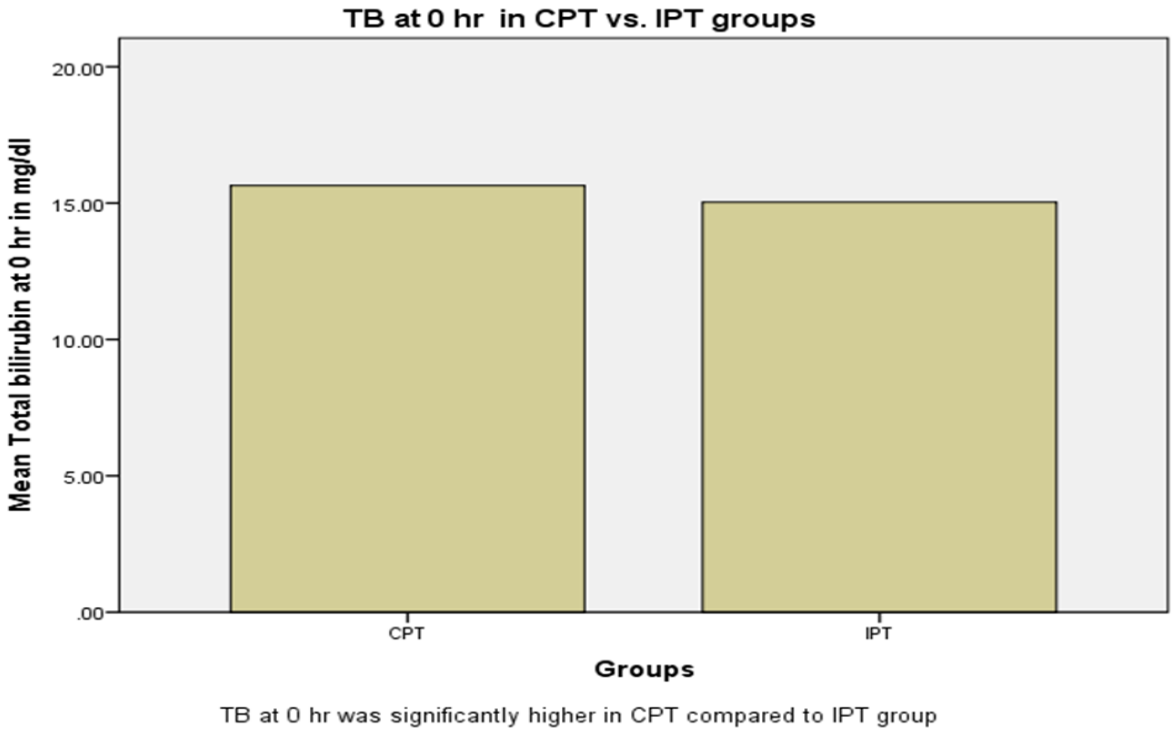
| Table no 7: Total serum bilirubim at 0 hr( admission) in CPT vs. IPT groups | | | | | |
|---|---|---|---|---|---|
| **CPT** | | **IPT** | | **t** | **p** |
| **TSB in mg/dl : n-91** | | **TSB in mg/dl : n-98** | | | |
| **Mean ± SD** | **SE (CI)** | **Mean ± SD** | **SE (CI)** | | |
| 15.64 ± 2.19 | 0.23 (15.18-16.1) | 15.03 ± 1.07 (14.69-15.37) | 0.17 | 2.13 | 0.034* |

**Legend to table no 7:** TSB at 0 hr was significantly higher in CPT compared to IPT group.

SD-Standard deviation; SE-Standard error of mean; CI-Confidence interval; CPT-Continuous phototherapy; IPT-Intermittent phototherapy.

P<0.05 is significant. Independent t test was used to assess significance of difference between groups.

**Figure no 11: TSB at 0 hr in CPT vs. IPT groups**




TB at 0 hr was significantly higher in CPT compared to IPT group

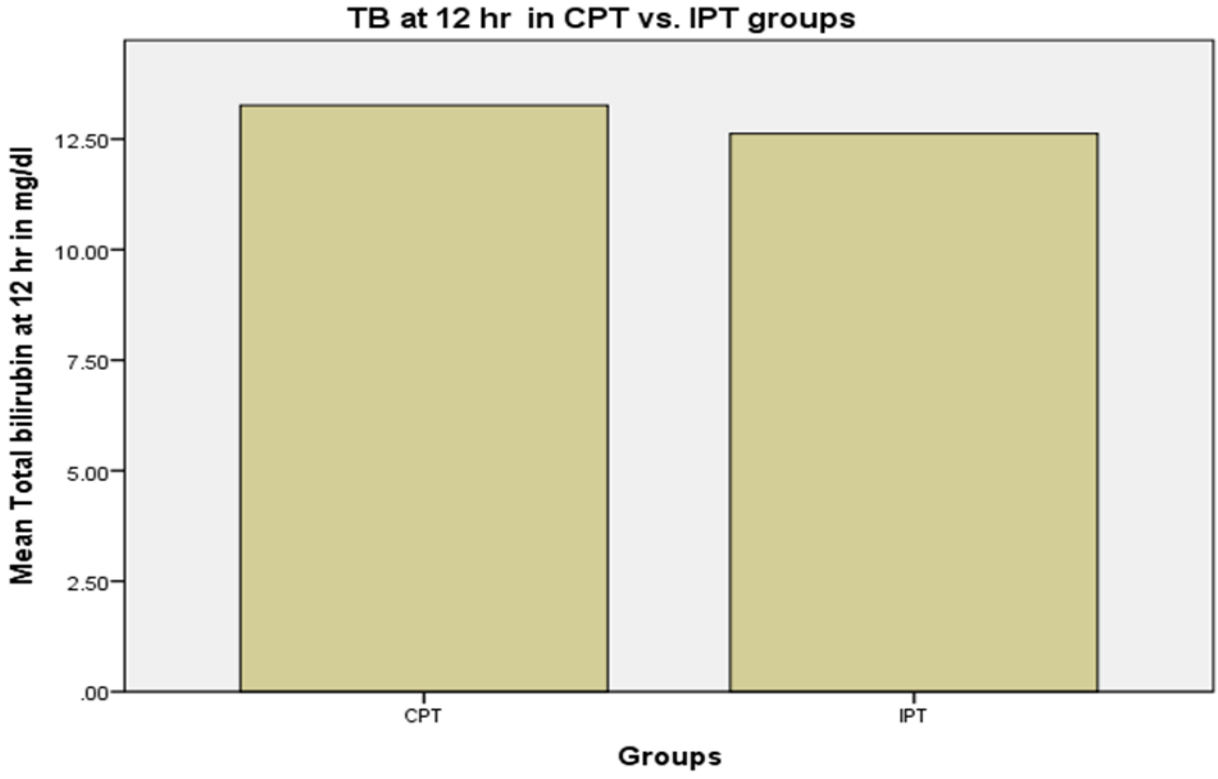
| Table no 8: Total serum bilirubin at 12 hr in CPT vs. IPT groups | | | | | |
|---|---|---|---|---|---|
| **CPT** | | **IPT** | | **t** | **p** |
| **TSB in mg/dl : n-91** | | **TSB in mg/dl : n-98** | | | |
| **Mean ± SD** | **SE (CI)** | **Mean ± SD** | **SE (CI)** | | |
| 13.26 ± 2.4 | 0.25 (12.76-13.76) | 12.6 ± 1.65 | 0.16 (12.29-12.95) | 2.14 | 0.034* |

**Legend to table no 8:** TSB at 12 hr was significantly higher in CPT compared to IPT group.

SD-Standard deviation; SE-Standard error of mean; CI-Confidence interval; CPT-Continuous phototherapy; IPT-Intermittent phototherapy.

P<0.05 is significant. Independent t test was used to assess significance of difference between groups.

**Figure no 12: Total serum bilirubin at 12 hr in CPT vs. IPT groups**




TB at 12 hr was significantly higher in CPT compared to IPT group

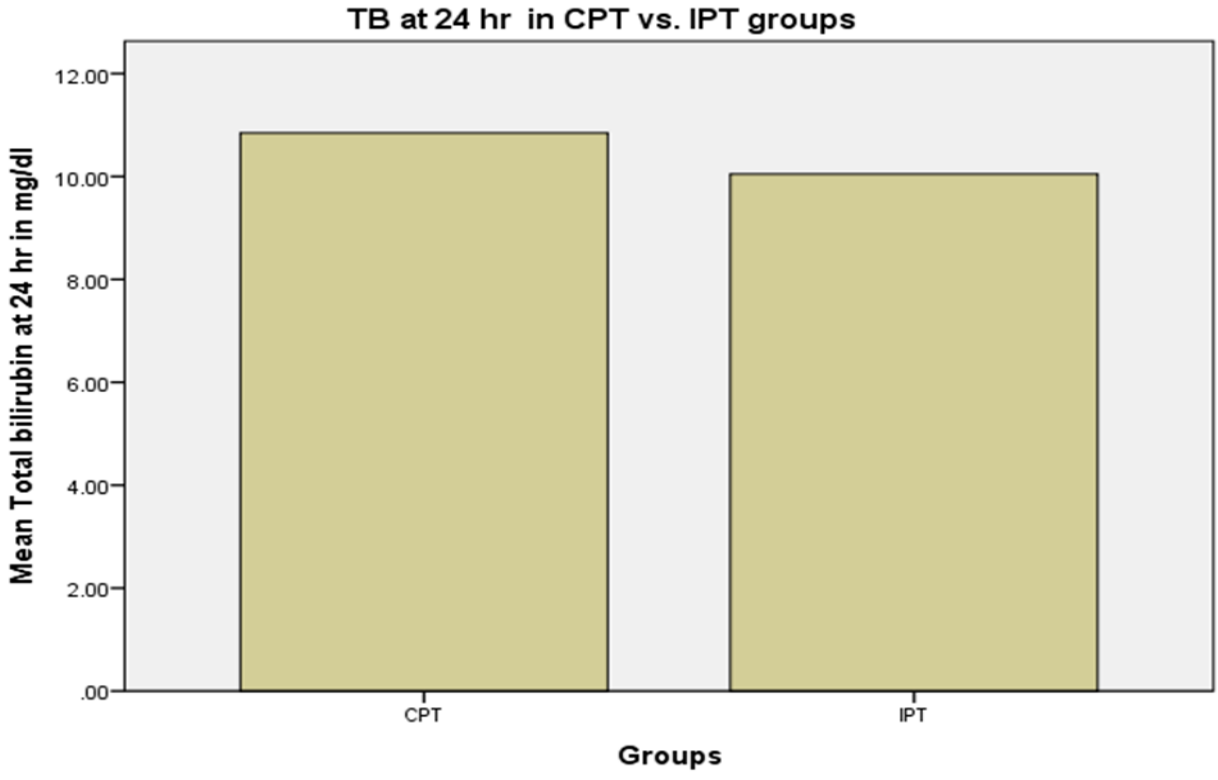
| Table no 9: Total serum bilirubin at 24 hr in CPT vs. IPT groups | | | | | |
|---|---|---|---|---|---|
| **CPT** | | **IPT** | | **t** | **p** |
| **TSB in mg/dl : n-71** | | **TSB in mg/dl : n-83** | | | |
| **Mean ± SD** | **SE (CI)** | **Mean ± SD** | **SE (CI)** | | |
| 10.8 ± 1.72 | 0.2 (10.44-11.25) | 10.04 ± 1.8 | 0.2 (9.65-10.44) | 2.79 | 0.006* |

**Legend to table no 9:** TSB at 24 hr was significantly higher in CPT compared to IPT group.

SD-Standard deviation; SE-Standard error of mean; CI-Confidence interval; CPT-Continuous phototherapy; IPT-Intermittent phototherapy.

P<0.05 is significant. Independent t test was used to assess significance of difference between groups.

**Figure no 13: Total serum bilirubin at 24 hr in CPT vs. IPT groups**




TB at 24 hr was significantly higher in CPT compared to IPT group

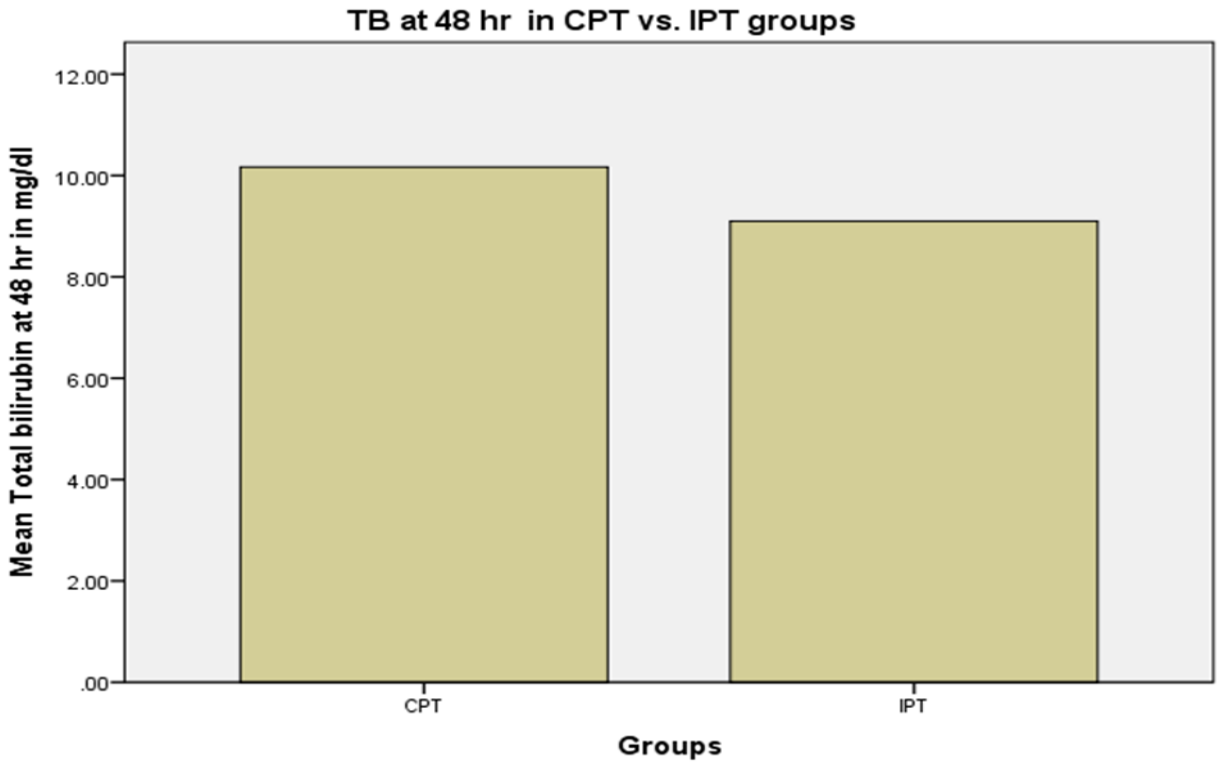
| Table no 10: Total serum bilirubin at 48 hr in CPT vs. IPT groups | | | | | |
|---|---|---|---|---|---|
| **CPT** | | **IPT** | | **t** | **p** |
| **TSB in mg/dl : n-21** | | **TSB in mg/dl : n-11** | | | |
| **Mean ± SD** | **SE (CI)** | **Mean ± SD** | **SE (CI)** | | |
| 10.16 ± 0.95 | 0.2 (9.73-10.6) | 9.1 ± 0.66 | 0.2 (8.65-9.54) | 3.3 | 0.002* |

**Legend to table no:** TSB at 48 hr was significantly higher in CPT compared to IPT group.

SD-Standard deviation; SE-Standard error of mean; CI-Confidence interval; CPT-Continuous phototherapy; IPT-Intermittent phototherapy.

P<0.05 is significant. Independent t test was used to assess significance of difference between groups.

**Figure no 14: Total serum bilirubin at 48 hr in CPT vs. IPT groups**




TB at 48 hr was significantly higher in CPT compared to IPT group.

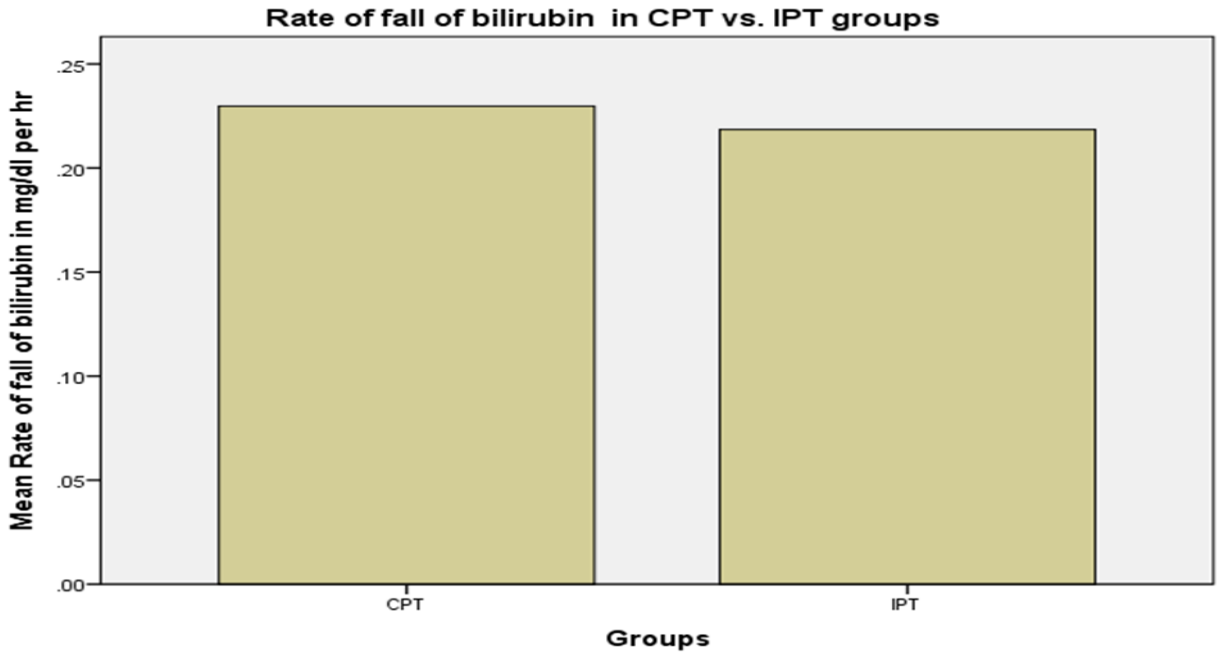
| Table no 11: Rate of fall of bilirubin in CPT vs. IPT groups | | | | | |
|---|---|---|---|---|---|
| **CPT** | | **IPT** | | **t** | **p** |
| **Rate of fall of TB in mg/dl/hr : n-91** | | **Rate of fall of TB in mg/dl/hr : n-98** | | | |
| **Mean ± SD** | **SE (CI)** | **Mean ± SD** | **SE (CI)** | | |
| 0.22 ± 0.12 | 0.01 (0.2-0.25) | 0.21 ± 0.08 | 0.008 (0.2-0.23) | 0.75 | 0.45 |

**Legend to table no 11:** Rate of fall of bilirubin was not significantly different in CPT compared to IPT group.

SD-Standard deviation; SE-Standard error of mean; CI-Confidence interval; CPT-Continuous phototherapy; IPT-Intermittent phototherapy.

P<0.05 is significant. Independent t test was used to assess significance of difference between groups.

**Figure no 15: Rate of fall of bilirubin in CPT vs. IPT groups**




Rate of fall of bilirubin was not significantly different in CPT compared to IPT group.

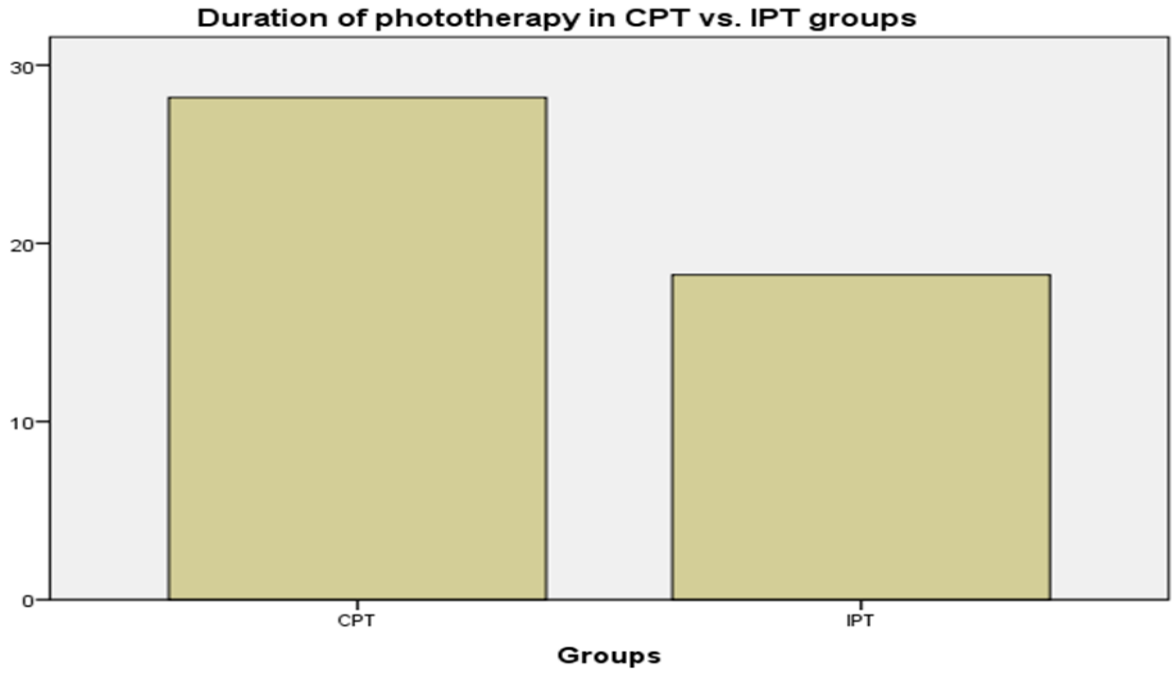
| Table no 12: Duration of phototherapy in CPT vs. IPT groups | | | | | |
|---|---|---|---|---|---|
| **CPT** | | **IPT** | | **Z** | **p** |
| **Duration of phototherapy in hours: n-91** | | **Duration of phototherapy in hours: n-98** | | | |
| **Median** | **IQR** | **Median** | **IQR** | | |
| 27 | 18 (18-36) | 18 | 9 (12-21) | -6.1 | <0.001* |

**Legend to table no 12:** Duration of phototherapy was significantly higher in CPT when compared to IPT groups.

IQR-Inter quartile range; CPT-Continuous phototherapy; IPT-Intermittent phototherapy.

P<0.05 is significant. Mann Whitney U test was used to assess significance of difference between groups.

**Figure no 16: Duration of phototherapy in CPT vs. IPT groups**




Duration of phototherapy was significantly higher in CPT when compared to IPT groups..

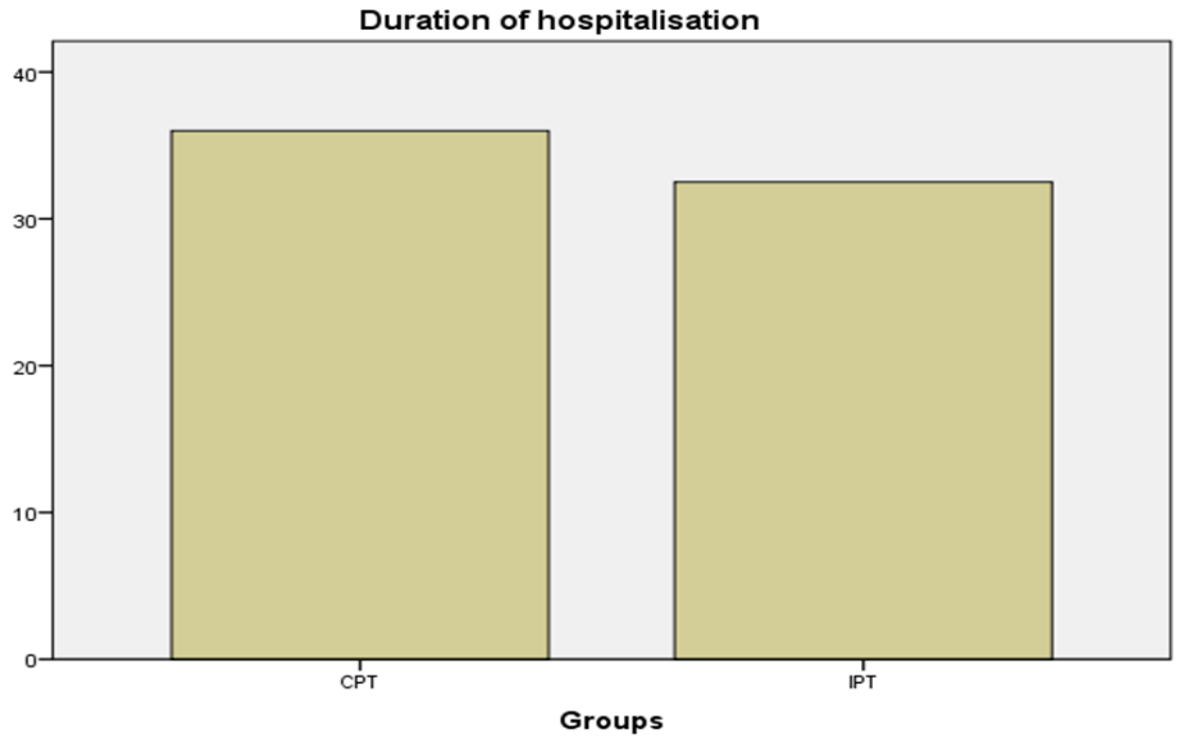
| Table no 13: Duration of hospitalization in CPT and IPT groups | | | | | |
|---|---|---|---|---|---|
| **CPT** | | **IPT** | | **Z** | **p** |
| **Duration of hospitalization in hrs: n-91** | | **Duration of hospitalization in hrs: n-98** | | | |
| **Median** | **IQR** | **Median** | **IQR** | | |
| 36 | 20 (24-44) | 32.5 | 18 (24-42) | -0.6 | 0.547 |

**Legend to table no 13:** Duration of hospitalization was not significantly different in CPT when compared to IPT groups though it was higher in CPT though it was higher in CPT

IQR-Inter quartile range; CPT-Continuous phototherapy; IPT-Intermittent phototherapy.

P<0.05 is significant. Mann Whitney U test was used to assess significance of difference between groups.

**Figure no 17: Duration of hospitalization in CPT and IPT groups**




Duration of hospitalisation was not significantly different in CPT and IPT

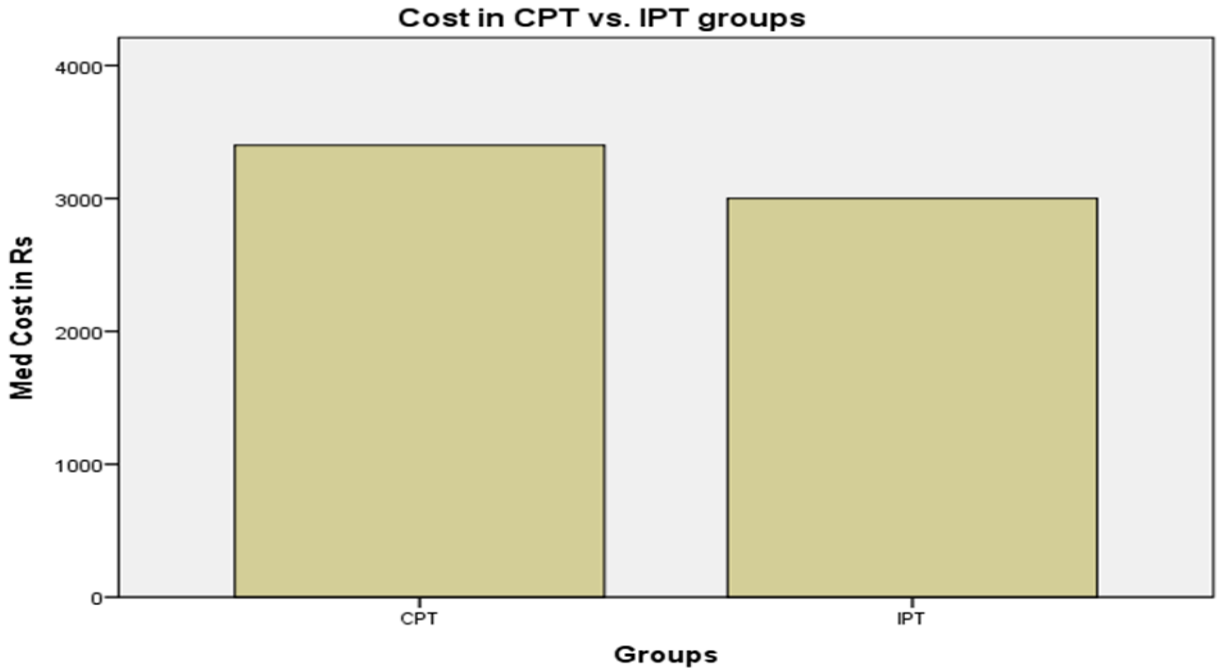
| Table no 14: Cost in CPT vs. IPT groups | | | | | |
|---|---|---|---|---|---|
| **CPT** | | **IPT** | | **Z** | **p** |
| **Cost in Rs: n-91** | | **Cost in Rs: n-98** | | | |
| **Median** | **IQR** | **Median** | **IQR** | | |
| 3400 | 2200 (2200-4400) | 3000 | 1800 (2200-4000) | -0.64 | 0.52 |

**Legend to table no 14:** Cost was not significantly different in CPT when compared to IPT groups though it was higher in CPT though it was higher in CPT

IQR-Inter quartile range; CPT-Continuous phototherapy; IPT-Intermittent phototherapy.

P<0.05 is significant. Mann Whitney U test was used to assess significance of difference between groups.

**Figure no 18: Cost in CPT vs. IPT groups**




Cost was not significantly different in CPT when compared to IPT groups though it was higher in CPT though it was higher in CPT

**Table no 15: Total Serum Bilirubin at 0,12,24 and 48 hr in CPT**

| | N | Mean | Std. Deviation | Minimum | Maximum | Percentiles | | | p |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 25th | 50th (Median) | 75th | <0.001 |
| **TSB at 0 hr in mg/dl** | 21 | 17.0429 | 2.03484 | 12.80 | 20.70 | 15.8000 | 17.5000 | 18.5000 | |
| **TSB at 12 hr in mg/dl** | 21 | 15.8952 | 1.65755 | 13.30 | 18.80 | 14.2000 | 15.5000 | 17.4000 | |
| **TSB at 24 hr in mg/dl** | 21 | 12.9667 | 1.15253 | 11.30 | 15.60 | 12.0500 | 12.9000 | 13.7500 | |
| **TSB at 48 hr in mg/dl** | 21 | 10.1667 | .94939 | 8.40 | 12.00 | 9.7000 | 10.0000 | 10.7500 | |

**Legend to table no 15:** TSB decreased significantly in CPT group.

SD-Standard deviation; SE-Standard error of mean; CI-Confidence interval; CPT-Continuous phototherapy; IPT-Intermittent phototherapy.

P<0.05 is significant; Friedmans test was used to assess significance of difference in TB.

**Table no 16: Total Serum Bilirubin at 0,12,24 and 48 hr in IPT**

| | N | Mean | Std. Deviation | Minimum | Maximum | Percentiles | | | p |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 25th | <0.001 | 75th | <0.001 |
| **TSB at 0 hr in mg/dl** | 11 | 15.8364 | 1.35593 | 14.10 | 18.60 | 14.8000 | | 16.6000 | |
| **TSB at 12 hr in mg/dl** | 11 | 14.1727 | 1.26893 | 12.60 | 16.20 | 13.0000 | | 15.0000 | |
| **TSB at 24 hr in mg/dl** | 11 | 13.0000 | 2.72544 | 11.50 | 21.10 | 12.0000 | | 13.0000 | |
| **TSB at 48 hr in mg/dl** | 11 | 9.1000 | .66332 | 8.10 | 10.20 | 8.7000 | | 9.7000 | |

**Legend to table no 16:** TSB decreased significantly in IPT group.

SD-Standard deviation; SE-Standard error of mean; CI-Confidence interval; CPT-Continuous phototherapy; IPT-Intermittent phototherapy.

P<0.05 is significant; Friedmans test was used to assess significance of difference in TB.

# DISCUSSION

The Current study results are represented in tables **(Table No: 1-16)** and figures **(Figure No: 6-18)**. 190 neonates who got admitted in NICU who were >34 weeks, both genders, both normal and lower segment caesarean-section deliveries, birth weight ≥ 2000gm and APGAR score > 7/10 at 1 min were included in the study over a period of 18 months.

This study was planned to find a way of reducing burden on nursing staff, and providing the parents a more acceptable way of treating their jaundiced babies. So we compared two types of giving phototherapy to the jaundiced neonates, continuous and intermittent. It also supports mother infant bonding in a cost effective manner.

For the group A babies, who received continuous phototherapy, the median age on admission was 76hrs, gestational age was 39±2 weeks, birth weight was 2.58±0.8kg, APGAR score at 1 min, 5min was 7±0 and 9±1 respectively, the mean baseline bilirubin at '0' hour was 15.64 ±2.19 mg/dl, the mean follow-up bilirubin at 12, 24, 48 hour was 13.26 ±2.4mg/dl, 10.8 ± 1.72 mg/dl, 10.16 ± 0.95mg/dl respectively and the rate of fall between the baseline and follow-up bilirubin was 0.22 ± 0.12mg/dl/hr, so there was significant decrease in bilirubin in group A babies.

For the group B babies, who received intermittent phototherapy, the median age on admission was 77 hrs, gestational age was 39±8 weeks, birth weight was 2.7kg, APGAR score at 1 min, 5min was 7±7 & 9±1 respectively, the mean baseline bilirubin at '0' hour was 15.03 ±1.07 mg/dl, the mean follow-up bilirubin at 12, 24, 48 hour was 12.6 ±1.65mg/dl, 10.04 ±1.8 mg/dl, 9.1 ± 0.66 mg/dl respectively and the rate of fall between the baseline and follow-up bilirubin was 0.21 ± 0.08 mg/dl/hr, so there was significant decrease in bilirubin in group B babies.

The present study observed age on admission in hours, gestational age distribution was not significantly different in CPT and IPT groups and also APGAR score at 1 min and at 5 min was not significantly different in both the groups. **(Table No: 1-4),** our results were similar to previous studies.[39,40,52]

Current study observed birth weight distribution in CPT in comparison with IPT group which was not significantly different in both the groups and also CRP distribution was not significantly different in CPT and IPT groups. **(Table No: 5-6).**

The present study observed duration of phototherapy was significantly higher in CPT when compared to IPT groups but duration of hospitalization and cost was not significantly different in CPT when compared to IPT groups though it was higher in CPT groups. **(Table No: 12-14)**

The difference between the mean baseline bilirubin, mean follow-up bilirubin, and the mean rate of fall in serum bilirubin for both the groups A and B was statistically not significant. **(Table 7-11)**. Our findings of this study were similar to those of Niknafs et al.,[40]., in that there was statistically no significant difference in the effectiveness (mean rate of fall in serum bilirubin) of both types of phototherapy.

**TABLE NO 17: PRIMARY OUTCOME**

| VARIABLE | PRESENT STUDY | | | PEDRAM NIKNAFS et al | | |
|---|---|---|---|---|---|---|
| | GROUPS | | | GROUPS | | |
| | IPT | CPT | p Value | IPT | CPT | P Value |
| TSB at 0 hour (admission) | 15.03±1.07 | 15.64±2.19 | 0.03 | 16.3±1.43 | 16.6±1.76 | 0.03 |
| 12 Hour | 12.6±1.65 | 13.26±2.4 | 0.03 | 13.57±2.3 | 13.73±1.89 | 0.6 |
| 24 Hour | 10.04±1.8 | 10.8±1.72 | 0.006 | 10.86±2.13 | 11.06±2.06 | 0.6 |
| 48 Hour | 9.1±0.66 | 10.16±0.95 | 0.002 | 9.02±1.94 | 9.17±1.83 | 0.7 |

**TABLE NO 18: PRIMARY OUTCOME**

| VARIABLE | PRESENT STUDY | | | MONICA SACHDEVA et al | | |
|---|---|---|---|---|---|---|
| | GROUPS | | | GROUPS | | |
| | IPT | CPT | p Value | IPT | CPT | p Value |
| Rate of fall of bilirubin mg/dl/hr | 0.21±0.08 | 0.22±0.12 | 0.45 | 0.18±0.6 | 0.13±0.4 | 0.001* |
| Duration of phototherapy in hours | 18 | 27 | <0.0001* | 24 | 30 | 0.0001* |
| Duration of hospitalisation in hours | 32.5 | 36 | 0.547 | 33 | 33 | 0.83 |

Although we applied phototherapy for prolonged duration (3 hour on and 45 min off for continuous, and 3 hour on and 3 hour off for intermittent group) compared to the above mentioned study (2 hours on and 30 minutes off for continuous and 1 hour on and 1 hour off for intermittent group). In their study the mean serum bilirubin level before the start of phototherapy was 16.60 ±1.67 mg/dl for continuous and 16.33±1.46 mg/dl for intermittent group, and the mean serum bilirubin at 36 hours was 9.17±1.83 mg/dl for continuous and 9.02±1.94 mg/dl for intermittent group, while in our study the mean serum bilirubin before the start of phototherapy was 15.64 ± 2.19 mg/dl for continuous and 15.03 ± 1.07 mg/dl for intermittent group, and the mean serum bilirubin at 12, 24, 48 hour was 13.26 ±2.4mg/dl,

10.8 ± 1.72 mg/dl, 10.16 ± 0.95mg/dl respectively for continuous and 12.6 ±1.65mg/dl, 10.04 ±1.8 mg/dl, 9.1 ± 0.66 mg/dl respectively for intermittent group, and mean rate of fall in serum bilirubin for continuous versus intermittent group was 0.22 ± 0.12mg/dl, 0.21 ± 0.08 respectively. In other words, in our study, the mean decrease in serum bilirubin was far less than theirs. This may be because of difference in the apparatus.[40]

Previous studies comparing intermittent versus continuous phototherapy have produced different results. As exposure to light increases excretion of bilirubin, continuous phototherapy would be more effective than intermittent one. Lau and Fung[39] showed that the difference in serum bilirubin kinetics between continuous and intermittent phototherapy was insignificant and a schedule of one in four hours of irradiation achieved the same treatment effect as continuous phototherapy. Whereas in our study we observed duration of phototherapy was significantly higher in CPT when compared to IPT groups which is similar to previous studies by, Maurer and Vogl[45,47] showed that intermittent phototherapy did not cause longer phototherapy periods this is because realizing photoisomerization occurs within minutes and bilirubun slowly migrates to the skin over hours , intermittent phototherapy regimens were hypothesizes to be effective and where tested , and as photoisomerization of bilirubin occurs primarily in the skin layers and the restoration of the bilirubin pool in the skin takes approximately 1-3 hours. Thus a prolonged on-off schedule may not be as effective as continuous therapy, but an on – off cycle of less than one hour is apparently as effective as continuous therapy.[40]

Besides its simplicity in application, it is also economically attractive for developing countries where the need is more and resources are poor. Furthermore, this regimen is less disruptive to the establishment of neonate-maternal bonding and breast feeding because the neonates are not confined to the incubators during the whole course of treatment. Moreover by involving mothers of the neonates in the nursing care (like cleaning, feeding, changing

diapers) of the babies, so the burden is shared between the mother and staff and they will spend more time (30 minutes off time) with their babies, so they will be more satisfied.

# CONCLUSION

On the basis of this study, it is concluded that intermittent phototherapy with 3 hour on and 3 hour off is as efficacious as continuous phototherapy in the treatment of neonatal indirect hyperbilirubinemia. Although intermittent and continuous phototherapies were found to be equally effective, Because of the additional benefits of intermittent phototherapy, like promoting exclusive breast feeding, KMC care, mother infant bonding, it can be adopted as a routine procedure instead of continuous phototherapy in neonatal care units, however studies with large sample size are needed for better confirmation.

# SUMMARY

- The study was a randomized interventional study.
- This was done in 190 neonates who got admitted in NICU who were >34 weeks, both genders, both normal and lower segment caesarean-section deliveries, birth weight ≥ 2000gm and APGAR score > 7/10 at 1 min were included in the study
- Rh incompatibility, ABO incompatibility, neonatal sepsis, any significant congenital malformation, Denial of consent were excluded from the study.
- Group A babies, who received continuous phototherapy, the median age on admission was 76hrs, gestational age was 39±2 weeks, birth weight was 2.58±0.8kg, APGAR score at 1 min, 5min was 7±0 & 9±1 respectively, the mean baseline bilirubin at '0' hour was 15.64 ±2.19 mg/dl, the mean follow-up bilirubin at 12, 24, 48 hour was 13.26 ±2.4mg/dl, 10.8 ± 1.72 mg/dl, 10.16 ± 0.95mg/dl respectively and the rate of fall between the baseline and follow-up bilirubin was 0.22 ± 0.12mg/dl, so there was significant decrease in bilirubin in group A babies.
- Group B babies, who received intermittent phototherapy, the median age on admission was 77 hrs, gestational age was 39±8 weeks, birth weight was 2.7kg, APGAR score at 1 min, 5min was 7±7 & 9±1 respectively, the mean baseline bilirubin at '0' hour was 15.03 ±1.07 mg/dl, the mean follow-up bilirubin at 12, 24, 48 hour was 12.6 ±1.65mg/dl, 10.04 ±1.8 mg/dl, 9.1 ± 0.66 mg/dl respectively and the rate of fall between the baseline and follow-up bilirubin was 0.21 ± 0.08 mg/dl, so there was significant decrease in bilirubin in group B babies.
- On the basis of this study, it was concluded that a phototherapy cycle of 3 hour on and 3 hour off is as effective as continuous phototherapy in the treatment of neonatal indirect hyperbilirubinemia in neonates.

# REFERENCES


1. Houshmandi M mehdi, Goodarzi R, Hamedi Y, Khamesan B, Yousefi F. Comparison of Two phototherapy Methods for Reducing Bilirubin of Neonates: Continuous vs. intermittent. Vol. 3, American journal of life science researches. 2015. 260–265 p.

2. Woodgate P, Jardine LA. Neonatal jaundice. BMJ Clin Evid. 2011;2011:319.

3. Reshad M, Ravichander B, Raghuraman T. A study of cord blood albumin as a predictor of significant neonatal hyperbilirubinemia in term and preterm neonates. Int J Res Med Sci. 2016;4(3):887–90.

4. A. K. Comparison of continuous with intermittent phototherapy in the treatment of neonatal jaundice. J Postgrad Med Inst. 2016;30(2):173–6.

5. Abdul-Kareem M. Comparison between continuous and intermittent phototherapy in the management of neonatal jaundice. Zanco J Med Sci (Zanco J Med Sci). 2018;15(2).

6. Sachdeva M, Murki S, Oleti TP, Kandraju H. Intermittent versus continuous phototherapy for the treatment of neonatal non-hemolytic moderate hyperbilirubinemia in infants more than 34 weeks of gestational age: a randomized controlled trial. Eur J Pediatr. 2015;174(2):177–81.

7. Boskabadi H, Maamouri G, Zadeh HM, Shakeri MT, Ghayour-Mobarhan M, Mohammadi S, et al. Comparison of serum zinc level between neonates with jaundice and healthy neonates. Shiraz E Med J. 2015;16(10):10–4.

8. Chandrakant VA, Patil VS, Ingleshwar DG, Patil VP. Neonatal Hyperbilirubinemia-Evaluation of Total Calcium , Ionised Calcium , Magnesium , Lactate and Electrolytes. Natl jounal Lab Med. 2017;1–6.

9. Fevery J. Bilirubin in clinical practice: a review. Liver Int. 2008 May;28(5):592–605.

10. Carl A. Burtis, Edward R. Ashwood and David E. Bruns (eds): Tietz Textbook of Clinical Chemistry and Molecular Diagnosis (5th edition): Elsevier, St. Louis, USA, 2012, 2238 pp, 909 illustrations. ISBN: 978-1-4160-6164-9. 2012/12/13. Vol. 28. 2013.

11. Wang X, Chowdhury JR, Chowdhury NR. Bilirubin metabolism: Applied physiology. Curr Paediatr. 2006;16(1):70–4.

12. Cohen RS, Wong RJ, Stevenson DK. Understanding neonatal jaundice: a perspective on causation. Pediatr Neonatol. 2010;51(3):143–8.

13. Bishop M, Fody E, Schoeff L. Clinical Chemistry - Techniques, Principles, Correlations. Techniques, Principles, Correlations. 2014. 522 p.

14. Chatterjea MN SR. bilirubin metabolism. Textbook of medical biochemistry. 2011.

15. Ostrow JD, Pascolo L, Shapiro SM, Tiribelli C. New concepts in bilirubin encephalopathy. Eur J Clin Invest. 2003;33(11):988–97.

16. Mohammadzadeh A, Farhat A shah, Alizadeh kaseb A, Khorakian F, Ramezani M. Prophylactic effect of zinc sulphate on hyperbilirubinemia in premature very low birth weight neonates: a randomized clinical trial. Iran J Neonatol IJN. 2015;5(4):6–10.

17. O'Dell BL. Role of zinc in plasma membrane function. J Nutr. 2000;130(5S Suppl):1432S-6S.

18. Singh H, Ahmed A, Gopalkrishna P V. Approach to Hyperbilirubinemia in Near Term Infants. 2016;3(6):1629–33.

19. Abdel Aziz RA, El-Mazary A-AM, Saidii AA. Can Exchange Transfusion Normalize

Serum Levels of Copper, Zinc, and Magnesium in Severe Neonatal Hyperbilirubinemia? J Pediatr Hematol Oncol. 2018;40(2):e121–6.

20. Olusanya BO, Osibanjo FB, Slusher TM. Risk factors for severe neonatal hyperbilirubinemia in low and middle-income countries: a systematic review and meta-analysis. PLoS One. 2015;10(2):e0117229.

21. Brites D, Fernandes A, Falcão AS, Gordo AC, Silva RFM, Brito MA. Biological risks for neurological abnormalities associated with hyperbilirubinemia. J Perinatol. 2009;29:S8.

22. Kliegman, Stanton SS. Digestive System Disorders, Text Book of Paediatrics. 20th ed. Kliegman R, Stanton B, St Geme JW, Schor NF, Behrman RE, editors. Philadelphia: Elsevier; 2016. 871–877 p.

23. Agarwal R, Kaushal M, Aggarwal R, Paul VK, Deorari AK. Early neonatal hyperbilirubinemia using first day serum bilirubin level. Vol. 39, Indian pediatrics. India; 2002. 724–730 p.

24. Parthasarathy. Care of Newborn. IAP Textbook of Paediatrics. 6th ed. Parthasarathy, editor. New Delhi; 2016. 49–51 p.

25. Hossain M, Begum M, Ahmed S, Absar N. Causes , Management and Immediate Complications of Management of Neonatal Jaundice --- A Hospital-Based Study. J Enam Med Coll. 2015;5(2):104–9.

26. Neonatal jaundice 2010 Available at [Internet]. 2016. Available from: https://www.nice.org.uk/guidance/cg98/evidence/full-guideline-245411821.

27. NNF 2010. Available at [Internet]. 2016. Available from: http://aimaonline.org/iap-neochap-2013/uploads/acdcorner/ nnf_guidelines-2011.pdf.

28. American Academy of Pediatrics Subcommittee on Hyperbilirubinemia. Management of hyperbilirubinemia in the newborn infant 35 or more weeks of gestation. Pediatrics. 2004;114(1):297–316.

29. Kramer LI. Advancement of dermal icterus in the jaundiced newborn. Am J Dis Child. 1969 Sep;118(3):454–8.

30. Yurdakök M. Phototherapy in the newborn: what's new? J Pediatr Neonat Individ Med. 2015;4(2):e040255.

31. Mreihil K, McDonagh AF, Nakstad B, Hansen TWR. Early isomerization of bilirubin in phototherapy of neonatal jaundice. Pediatr Res. 2010 Jun;67(6):656–9.

32. McDonagh AF, Vreman HJ, Wong RJ, Stevenson DK. Photoisomers: obfuscating factors in clinical peroxidase measurements of unbound bilirubin? Pediatrics. 2009 Jan;123(1):67–76.

33. Okada H, Abe T, Etoh Y, Yoshino S, Kato I, Iwaki T, et al. In vitro production of bilirubin photoisomers by light irradiation using neoBLUE. Pediatr Int. 2007 Jun;49(3):318–21.

34. Mills JF, Tudehope D. Fibreoptic phototherapy for neonatal jaundice. Cochrane database Syst Rev. 2001;(1):CD002060.

35. Abd Hamid IJ, M Iyen MII, Ibrahim NR, Abd Majid N, Ramli N, Van Rostenberghe H. Randomised controlled trial of single phototherapy with reflecting curtains versus double phototherapy in term newborns with hyperbilirubinaemia. J Paediatr Child Health. 2013 May;49(5):375–9.

36. Sherbiny HS, Youssef DM, Sherbini AS, El-Behedy R, Sherief LM. High-intensity light-emitting diode vs fluorescent tubes for intensive phototherapy in neonates.

Paediatr Int Child Health. 2016 May;36(2):127–33.

37. Boonyarittipong P, Kriangburapa W, Booranavanich K. Effectiveness of double-surface intensive phototherapy versus single-surface intensive phototherapy for neonatal hyperbilirubinemia. J Med Assoc Thai. 2008 Jan;91(1):50–5.

38. Tayman C, Tatli MM, Aydemir S, Karadag A. Overhead is superior to underneath light-emitting diode phototherapy in the treatment of neonatal jaundice: a comparative study. J Paediatr Child Health. 2010 May;46(5):234–7.

39. Lau SP, Fung KP. Serum bilirubin kinetics in intermittent phototherapy of physiological jaundice. Arch Dis Child. 1984 Sep;59(9):892–4.

40. Niknafs P, Mortazavi A-A, Hossein Torabinejad M, Bijari B, Niknafs N. Intermittent Versus Continuous Phototherapy for Reducing Neonatal Hyperbilirubinemia. Vol. 18, Iranian Journal of Pediatrics (ISSN: 1018-4406) Vol 18 Num 3. 2008.

41. Maisels MJ. Managing the jaundiced newborn: a persistent challenge. C Can Med Assoc J. 2015;187(5):335–43.

42. Tan KL. Phototherapy for neonatal jaundice. Clin Perinatol. 1991;18(3):423–39.

43. Scheidt PC, Bryla DA, Nelson KB, Hirtz DG, Hoffman HJ. Phototherapy for neonatal hyperbilirubinemia: six-year follow-up of the National Institute of Child Health and Human Development clinical trial. Pediatrics. 1990;85(4):455–63.

44. Maisels MJ, McDonagh AF. Phototherapy for neonatal jaundice. N Engl J Med. 2008;358(9):920–8.

45. Maurer HM, Shumway CN, Draper DA, Hossaini AA. Controlled trial comparing agar, intermittent phototherapy, and continuous phototherapy for reducing neonatal hyperbilirubinemia. J Pediatr. 1973 Jan;82(1):73–6.

46. Lau SP FK. Serum bilirubin kinetics in intermittent phototherapy of physiological jaundice. Arch Dis Child. 1984;59:892–894.

47. Vogl TP, Hegyi T HI. Intermediate phototherapy in the treatment of jaundice in the premature infant. J Pediatr. 1978;92.(4):627–30.

48. Ip S, Chung M, Kulig J, O'Brien R, Sege R, Glicken S, et al. An evidence-based review of important issues concerning neonatal hyperbilirubinemia. Pediatrics. 2004 Jul;114(1):e130-53.

49. Maisels MJ. Neonatal jaundice. Pediatr Rev. 2006 Dec;27(12):443–54.

50. Silva I, Luco M, Tapia JL, Perez ME, Salinas JA, Flores J, et al. Single vs. double phototherapy in the treatment of full-term newborns with nonhemolytic hyperbilirubinemia. J Pediatr (Rio J). 2009;85(5):455–8.

51. Bhatta B, Shrestha P. A Comparative Study Of Rate Of Fall Of Total Serum Bilirubin In Jaundiced Babies Following Continuous And Intermittent Phototherapy. J Nepal Med Assoc. 2003 Sep 1;42(149 SE-Original Article).

52. Khaliq A. Comparison of continuous with intermittent phototherapy in the treatment of neonatal jaundice. J Postgrad Med Inst. 2016;30(2):173–6.

**Annexure – I**

**ETHICAL CLEARANCE CERTIFICATE**

## ANNEXURE-II

**B.L.D.E.U. SHRI B.M.PATIL MEDICAL COLLEGE HOSPITAL AND RESEARCH CENTRE, VIJAYAPUR-586103**

RESEARCH INFORMED CONSENT FORM

**TITLE OF THE PROJECT:** CONTINUOUS AND INTERMITTENT PHOTOTHERAPY IN THE MANAGEMENT OF NEONATAL HYPERBILIRUBINEMIA- A RANDOMISED INTERVENTION STUDY.

**P.G.GUIDE** : Dr.

PROFESSSOR

DEPARTMENT OF PAEDIATRICS

**PG STUDENT :** Dr.

P.G. DEPARTMENT OF PAEDIATRICS

**PURPOSE OF RESEARCH:**

I have been informed that this study will help in management of neonatal hyperbilirubinemia

**PROCEDURE:**

I am aware that in addition to routine care received, I will be asked series of questions by the investigator. I have been asked to undergo the necessary investigations which will help the investigator in this study.

**RISK AND DISCOMFORTS:**

I understand there is no risk involved and that the baby may experience some pain and discomforts during the examination. This is mainly the result of the condition and the procedures of this study are not expected to exaggerate these feelings which are associated with the usual course of treatment.

**BENEFITS:**

I understand that participation in the study will help the investigator to know whether intermittent as compared to continous phototherapy is more effective, acceptable, cost effective and useful in providing day care to the neonate which are useful in the management of hyperbilirubinemia.

**CONFIDENTIALITY:**

I understand that the medical information produced by this study will become a part of hospital records and will be subject to the confidentiality. Information of sensitive personal nature will not be part of the medical record, but will be stored in the investigations research file.

If the data are used for publication in the medical literature or for teaching purpose, no name will be used and other identifiers such as photographs will be used only with special written permission. I understand that I may see the photograph before giving the permission.

**REQUEST FOR MORE INFORMATION:**

I understand that I may ask more questions about the study at any time; Dr. Gowthami G S at the department of pediatrics is available to answer my questions or concerns. I understand that I will be informed of any significant new findings discovered during the course of the study, which might influence my continued participation. A copy of this consent form will be given to me to keep for careful reading.

**REFUSAL FOR WITHDRAWAL OF PARTICIPATION:**

I understand that my participation is voluntary and that I may refuse to participate or may withdraw consent and discontinue participation in the study at any time without prejudice. I also understand that Dr. may terminate my participation in the study after she has explained the reasons for doing so.

**INJURY STATEMENT:**

I understand that in the unlikely event of injury to the baby resulting directly from participation in this study, if such injury were reported promptly, the appropriate treatment would be available to the baby. But, no further compensation would be provided by the hospital. I understand that by my agreements to participate in this study and not waiving any of my legal rights.

I have explained to _____the purpose of the research, the procedures required and the possible risks to the best of my ability.

_____ _____

Dr. Date

(Investigator)

**PARENTS / GUARDIAN CONSENT STATEMENT:**

We confirm that Dr is doing a "CONTINUOUS AND INTERMITTENT PHOTOTHERAPY IN THE MANAGEMENT OF HYPERBILIRUBINEMIA- A RANDOMISED INTERVENTION STUDY", has explained to us the purpose of research and the study procedure. We are willing to allow our baby to undergo investigations and the possible discomforts as well as benefits. We have been explained all the above in detail in our own language and we understand the same. Therefore we agree to give consent for our baby to participate as a subject in this research project.

_____ _____

(Parents / Guardian) Date

_____ _____

(Witness to signature) Date

**Annexure – III**

**PROFORMA**

**SCHEME OF CASE TAKING :**

Name :

Sex : IP NO :

Religion : DOB :

Postal address: DOD :

Age of the mother : Education of mother :

Age of father : Education of father :

Occupation of mother : Occupation of father :

Antenatal registration (Yes/No):

Gravida : 1 / 2 / 3 / 4 / > 5

Gestational age :

Mode of delivery (Normal vaginal/Caesarean/Forceps/Vacum):

APGAR score :

Maternal obstetric history: significant /not significant ,if significant specify

GENERAL PHYSICAL EXAMINATION:

Birth weight…….gm

HR : RR : HC :

CFT : TEMP: LENGTH:

SYSTEMIC EXAMINATION:

CVS:

RESPIRATORY SYSTEM:

GASTRO – INTESTINAL SYSTEM:

CNS:

**CLINICAL EVALUATION OF JAUNDICE (KRAMER INDEX):**

| Skin of | DAY 3 | DAY 4 | DAY5 | DAY6 | DAY7 |
|---|---|---|---|---|---|
| FORE HEAD 4-6 mg/dl | | | | | |
| CHEST 6-8 mg/dl | | | | | |
| ABDOMEN 8-12m g/dl | | | | | |
| LEGS 12-14mg/dl | | | | | |
| PALMS AND SOLES.> 15mg/dl | | | | | |

**INVESTIGATIONS**:

Blood group and Rh typing:

| Total serum bilirubin (mg/dl) | Group A CPT | Group B IPT |
|---|---|---|
| 0 hour | | |
| 12th hour | | |
| 24th hour | | |
| 48th hour | | |
| 72th hour | | |

RATE OF FALL OF BILIRUBIN(mg/dl/hr):

| DURATION | RATE OF FALL |
|---|---|
| 0 -12 HOUR | |
| 12-24 HOUR | |
| 24-48 HOUR | |
| 48-72 HOUR | |

DURATION OF PHOTOTHERAPY (hours):

DURATION OF HOSPITALISATION (hours):

COST:

CRP:

**FOLLOW UP**

| DATE | BILIRUBIN LEVEL mg/dl | ACTION |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

**Final diagnosis:**

# MASTERCHART

| SL No | IP No | Age on admission(Hr) | Sex | ANC Registration | Gravida | Gestational age (WEEKS) | Mode of delivery | APGAR 1min | APGAR 5min | Obstetric h/o | Birth wt | Blood group Mother | Blood group Baby |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 23041 | 68 | F | yes | Multi | 35 | LSCS | 7 | 9 | PROM | 2.7 | B+ | A+ |
| 2 | 22976 | 72 | M | Y | Primi | 40 | LSCS | 7 | 9 | PROM | 2.7 | O+ | O+ |
| 3 | 22909 | 99 | F | Y | M | 35 | LSCS | 7 | 9 | | 2.4 | A+ | A+ |
| 4 | 23626 | 98 | M | Y | M | 40 | NVD | 7 | 9 | PROM | 2.54 | B+ | AB+ |
| 5 | 23754 | 74 | M | Y | P | 39 | NVD | 7 | 9 | | 2.54 | B+ | A+ |
| 6 | 23775 | 80 | M | Y | P | 41 | LSCS | 7 | 9 | | 2.8 | B+ | B+ |
| 7 | 36031 | 150 | M | Y | M | 37 | LSCS | 7 | 9 | | 2.5 | O+ | O+ |
| 8 | 36371 | 65 | F | Y | P | 38 | NVD | 7 | 9 | | 2.94 | AB+ | A+ |
| 9 | 23724 | 105 | M | Y | M | 41 | LSCS | 7 | 9 | | 2.9 | B+ | O+ |
| 10 | 24166 | 83 | M | Y | P | 37 | LSCS | 7 | 9 | | 3.5 | A+ | O+ |
| 11 | 24208 | 62 | F | Y | M | 41 | LSCS | 7 | 9 | | 2.2 | O+ | O+ |
| 12 | 24175 | 81 | F | Y | M | 39 | LSCS | 7 | 9 | | 3.1 | O+ | O+ |
| 13 | 23827 | 83 | F | Y | P | 40 | LSCS | 7 | 9 | | 3.13 | O+ | O+ |
| 14 | 24415 | 93 | F | Y | M | 39 | LSCS | 7 | 9 | | 2.54 | O+ | O+ |
| 15 | 25889 | 62 | F | Y | M | 39 | LSCS | 7 | 9 | | 3.24 | A+ | O+ |
| 16 | 25385 | 80 | M | Y | P | 40 | LSCS | 7 | 9 | | 3.02 | B+ | AB+ |
| 17 | 24212 | 101 | M | Y | M | 40 | LSCS | 7 | 9 | | 3.02 | B+ | O+ |
| 18 | 25540 | 72 | M | Y | P | 39 | NVD | 7 | 9 | | 2.44 | B+ | B+ |
| 19 | 25505 | 82 | M | Y | M | 39 | NVD | 7 | 9 | | 2.1 | B+ | B+ |
| 20 | 25570 | 81 | F | Y | M | 40 | NVD | 7 | 9 | | 2.18 | O+ | O+ |
| 21 | 25680 | 88 | M | Y | P | 38 | LSCS | 7 | 9 | | 3.07 | A+ | A+ |
| 22 | 25700 | 75 | F | Y | M | 37 | NVD | 7 | 9 | | 2.34 | A+ | O+ |
| 23 | 25977 | 65 | F | Y | M | 38 | NVD | 7 | 9 | | 2 | B+ | A+ |
| 24 | 25979 | 57 | F | Y | M | 40 | LSCS | 7 | 9 | | 2.5 | B+ | AB+ |
| 25 | 25909 | 68 | F | Y | P | 37 | NVD | 7 | 9 | | 2.22 | O+ | O+ |
| 26 | 25886 | 96 | M | Y | M | 39 | LSCS | 7 | 9 | | 2.45 | B+ | O+ |
| 27 | 26096 | 129 | F | Y | M | 41 | LSCS | 7 | 9 | | 3.34 | B+ | B+ |
| 28 | 26530 | 54 | M | Y | P | 40 | NVD | 7 | 9 | | 2.62 | O+ | O+ |
| 29 | 26437 | 73 | F | Y | M | 40 | NVD | 7 | 9 | | 2.42 | O+ | O+ |
| 30 | 29214 | 78 | F | Y | M | 37 | LSCS | 7 | 9 | | 2.3 | AB+ | A- |
| 31 | 26913 | 51 | M | Y | P | 39 | LSCS | 7 | 9 | | 2.53 | B+ | B+ |
| 32 | 26831 | 70 | M | Y | P | 39 | LSCS | 7 | 9 | | 2.62 | O+ | O+ |
| 34 | 29063 | 94 | M | Y | P | 40 | LSCS | 7 | 9 | | 3.4 | B+ | A+ |
| 35 | 5207 | 113 | M | Y | P | 40 | LSCS | 7 | 9 | PROM | 3.2 | B+ | B+ |
| 36 | 28916 | 39 | M | Y | M | 38 | NVD | 7 | 9 | | 3.25 | A+ | O+ |
| 37 | 28294 | 102 | F | Y | M | 39 | LSCS | 7 | 9 | PROM | 2.7 | O+ | O+ |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 38 | 28016 | 151 | M | Y | P | 40 | LSCS | 7 | 9 | BREECH | 2.5 | B+ | B+ |
| 39 | 28126 | 81 | M | Y | P | 40 | LSCS | 7 | 9 | | 3.55 | B+ | B+ |
| 40 | 28565 | 50 | F | Y | M | 40 | NVD | 7 | 9 | | 2.62 | B+ | A+ |
| 41 | 28506 | 104 | M | Y | M | 37 | LSCS | 7 | 9 | OLIGO | 2.5 | B+ | A+ |
| 42 | 28744 | 94 | M | Y | M | 39 | LSCS | 7 | 9 | | 3 | A+ | A+ |
| 43 | 28707 | 102 | M | Y | M | 41 | LSCS | 7 | 9 | | 3.9 | O+ | O+ |
| 44 | 28896 | 106 | M | Y | M | 38 | LSCS | 7 | 9 | | 3.7 | B+ | B+ |
| 45 | 28755 | 118 | M | Y | M | 37 | LSCS | 7 | 9 | | 2.5 | B+ | O+ |
| 46 | 29118 | 92 | M | Y | M | 39 | LSCS | 7 | 9 | | 2.8 | B+ | AB+ |
| 47 | 29122 | 78 | F | Y | P | 37 | LSCS | 7 | 9 | | 2.26 | A+ | A+ |
| 48 | 5896 | 72 | M | Y | P | 39 | LSCS | 7 | 9 | | 3.4 | A+ | O+ |
| 49 | 29261 | 129 | M | Y | P | 37 | LSCS | 7 | 9 | | 2.7 | A+ | B+ |
| 50 | 27877 | 82 | F | Y | P | 34 | NVD | 7 | 9 | | 2.08 | A+ | AB- |
| 51 | 29755 | 84 | M | Y | P | 40 | NVD | 7 | 9 | | 3.14 | O+ | O+ |
| 52 | 31674 | 100 | F | Y | P | 39 | LSCS | 7 | 9 | | 3.2 | AB+ | B+ |
| 53 | 31201 | 81 | M | Y | M | 39 | NVD | 7 | 9 | | 3.14 | B+ | O+ |
| 54 | 31080 | 104 | F | Y | M | 38 | LSCS | 7 | 9 | | 2.74 | A+ | O+ |
| 55 | 2943 | 72 | F | Y | M | 40 | LSCS | 7 | 9 | | 2.4 | O+ | O+ |
| 56 | 7453 | 60 | F | Y | P | 40 | NVD | 7 | 9 | | 2.5 | B+ | O+ |
| 57 | 31183 | 86 | M | Y | P | 41 | NVD | 7 | 9 | | 3.2 | A+ | O+ |
| 58 | 1978 | 120 | F | Y | P | 37 | LSCS | 7 | 9 | | 2.5 | O+ | O+ |
| 59 | 7663 | 120 | M | Y | P | 37 | NVD | 7 | 8 | | 2.4 | A+ | A+ |
| 60 | 40430 | 72 | F | Y | P | 38 | LSCS | 7 | 8 | | 2.83 | B+ | B+ |
| 61 | 3973 | 72 | M | Y | P | 38 | LSCS | 7 | 9 | | 3.05 | O+ | O+ |
| 62 | 8538 | 72 | M | Y | P | 40 | NVD | 7 | 9 | | 3.1 | A+ | A+ |
| 63 | 8696 | 68 | M | Y | P | 38 | LSCS | 7 | 9 | | 2.6 | O+ | O+ |
| 64 | 8517 | 127 | M | Y | M | 37 | LSCS | 7 | 9 | | 2.7 | O+ | O+ |
| 65 | 8442 | 117 | M | Y | M | 38 | LSCS | 7 | 9 | | 3 | B+ | B+ |
| 66 | 8326 | 70 | F | Y | M | 36 | LSCS | 7 | 9 | | 2.9 | B+ | B+ |
| 67 | 8782 | 98 | M | Y | M | 36 | LSCS | 7 | 9 | | 2.5 | B+ | AB+ |
| 68 | 9105 | 45 | F | Y | P | 39 | NVD | 7 | 9 | | 2.8 | B+ | B+ |
| 69 | 8861 | 92 | F | Y | M | 38 | LSCS | 7 | 9 | | 2.9 | A+ | A+ |
| 70 | 9170 | 68 | F | Y | P | 38 | NVD | 7 | 9 | | 2.5 | A+ | O+ |
| 71 | 1083 | 69 | F | Y | M | 38 | LSCS | 7 | 9 | | 2.25 | A+ | AB+ |
| 72 | 9171 | 100 | M | Y | M | 37 | LSCS | 7 | 9 | | 2.8 | B+ | O+ |
| 73 | 9542 | 48 | F | Y | P | 39 | NVD | 7 | 9 | | 2.1 | A+ | A+ |
| 74 | 9841 | 72 | M | Y | P | 38 | NVD | 7 | 9 | | 2.3 | B+ | A+ |
| 75 | 9854 | 77 | M | Y | P | 38 | LSCS | 7 | 9 | | 2.7 | O+ | O+ |
| 76 | 9526 | 63 | M | Y | M | 40 | NVD | 7 | 9 | | 2.1 | A+ | A- |
| 77 | 9993 | 78 | M | Y | M | 38 | LSCS | 7 | 9 | | 3 | O+ | O+ |
| 78 | 10102 | 72 | F | Y | M | 37 | NVD | 7 | 9 | | 2.5 | A+ | A+ |
| 79 | 10254 | 77 | F | Y | P | 39 | LSCS | 7 | 9 | | 2.7 | A+ | A+ |
| 80 | 10230 | 72 | M | Y | P | 39 | LSCS | 7 | 9 | | 3 | AB+ | A+ |
| 81 | 10245 | 72 | M | Y | P | 40 | NVD | 7 | 9 | | 2.8 | O+ | O+ |
| 82 | 10359 | 76 | M | Y | P | 39 | LSCS | 7 | 9 | | 2.8 | A+ | B+ |
| 83 | 10582 | 68 | F | Y | M | 39 | LSCS | 7 | 9 | | 2.4 | O+ | O+ |
| 84 | 10820 | 69 | F | Y | M | 40 | NVD | 7 | 9 | | 3.4 | AB+ | A+ |
| 85 | 10909 | 86 | M | Y | M | 39 | NVD | 7 | 9 | | 2.8 | B+ | O+ |
| 86 | 10942 | 71 | F | Y | P | 39 | NVD | 7 | 9 | | 2.2 | O+ | O+ |
| 87 | 3375 | 48 | M | Y | P | 39 | NVD | 7 | 9 | | 3.02 | B+ | O+ |
| 88 | 11186 | 89 | M | Y | P | 37 | LSCS | 7 | 9 | | 3.2 | O+ | O+ |
| 89 | 11212 | 108 | M | Y | P | 35 | LSCS | 7 | 9 | | 2.5 | AB+ | AB- |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 90 | 11498 | 70 | F | Y | M | 39 | LSCS | 7 | 9 | | 2.7 | A+ | A+ |
| 91 | 11595 | 62 | M | Y | P | 41 | LSCS | 7 | 9 | | 3.4 | O- | O- |
| 92 | 11621 | 55 | M | Y | M | 38 | LSCS | 7 | 9 | | 2.5 | O+ | O+ |
| 93 | 11882 | 58 | M | Y | P | 38 | NVD | 7 | 9 | HTN | 2.3 | B+ | O- |
| 94 | 11384 | 94 | F | Y | P | 40 | LSCS | 7 | 9 | | 2.5 | A+ | A+ |
| 95 | 11903 | 72 | M | Y | P | 38 | NVD | 7 | 9 | | 2.5 | A+ | O+ |
| 96 | 11814 | 84 | F | Y | P | 39 | NVD | 7 | 9 | | 2.8 | B+ | O+ |
| 97 | 2424 | 96 | F | Y | P | 40 | LSCS | 7 | 9 | | 3 | A+ | AB+ |
| 98 | 11757 | 168 | F | Y | M | 38 | LSCS | 7 | 9 | | 2.8 | B+ | A+ |
| 99 | 12205 | 74 | F | Y | P | 38 | LSCS | 7 | 9 | HTN | 2.4 | B+ | O+ |
| 100 | 143344 | 70 | M | Y | M | 36 | LSCS | 7 | 9 | | 2.7 | A+ | A+ |
| 101 | 7706 | 72 | F | Y | P | 37 | LSCS | 7 | 9 | | 2.7 | B+ | B+ |
| 102 | 13028 | 70 | F | Y | M | 40 | LSCS | 7 | 9 | | 2.9 | A+ | A+ |
| 103 | 3518 | 80 | F | Y | P | 39 | LSCS | 7 | 9 | | 3.1 | B+ | B+ |
| 104 | 11484 | 75 | M | Y | P | 39 | NVD | 7 | 9 | | 3.08 | O+ | O- |
| 105 | 14298 | 128 | F | Y | P | 36 | LSCS | 7 | 9 | | 2.7 | B+ | O+ |
| 106 | 13960 | 42 | M | Y | M | 37 | NVD | 7 | 9 | | 2.7 | B+ | A+ |
| 107 | 14632 | 90 | M | Y | M | 40 | NVD | 7 | 9 | | 3 | AB+ | AB+ |
| 108 | 15008 | 76 | F | Y | P | 39 | LSCS | 7 | 9 | | 3 | B+ | B+ |
| 109 | 14823 | 107 | M | Y | M | 35 | LSCS | 7 | 9 | | 2.5 | B+ | AB+ |
| 110 | 14822 | 103 | M | Y | M | 35 | LSCS | 7 | 9 | | **2.6** | B+ | O+ |
| 111 | 15048 | 71 | M | Y | P | 38 | LSCS | 7 | 9 | | 2.7 | A+ | AB+ |
| 112 | 15166 | 76 | M | Y | M | 35 | NVD | 7 | 9 | | 2.4 | B+ | B+ |
| 113 | 15177 | 72 | M | Y | P | 37 | NVD | 7 | 9 | | 2.2 | O+ | O+ |
| 114 | 15050 | 69 | F | Y | M | 40 | NVD | 7 | 9 | | 3.1 | AB+ | B+ |
| 115 | 15285 | 77 | M | Y | P | 41 | LSCS | 7 | 9 | | 3.2 | B+ | O+ |
| 116 | 15289 | 74 | F | Y | M | 39 | LSCS | 7 | 9 | | 3.2 | O- | O- |
| 117 | 15310 | 62 | M | Y | M | 40 | NVD | 7 | 9 | | 3.2 | B+ | B+ |
| 118 | 15622 | 88 | M | Y | M | 38 | LSCS | 7 | 9 | | 2.9 | O+ | O+ |
| 119 | 15725 | 103 | M | Y | M | 39 | LSCS | 7 | 9 | | 2.9 | A+ | AB+ |
| 120 | 15761 | 66 | F | Y | M | 39 | LSCS | 7 | 9 | | 2.5 | O+ | O- |
| 121 | 15897 | 68 | M | Y | M | 40 | NVD | 7 | 9 | | 2.6 | A- | A- |
| 122 | 15759 | 79 | F | Y | M | 39 | LSCS | 7 | 9 | | 2.3 | A+ | A+ |
| 123 | 16045 | 67 | F | Y | M | 38 | NVD | 7 | 9 | | 3.6 | O+ | O+ |
| 124 | 16058 | 58 | M | Y | M | 38 | NVD | 7 | 9 | | 2.3 | B+ | AB+ |
| 125 | 16719 | 84 | F | Y | M | 38 | LSCS | 7 | 9 | | 3 | A+ | A+ |
| 126 | 16339 | 108 | M | Y | P | 39 | LSCS | 7 | 9 | | 3.2 | B+ | O+ |
| 127 | 16936 | 65 | M | Y | P | 40 | NVD | 7 | 9 | | 3.3 | B+ | B+ |
| 128 | 16722 | 48 | M | Y | M | 40 | LSCS | 7 | 9 | | 3.2 | O+ | O+ |
| 129 | 15315 | 72 | F | Y | P | 39 | LSCS | 7 | 9 | | 2.6 | A+ | O+ |
| 130 | 16945 | 81 | M | Y | M | 40 | LSCS | 7 | 9 | | 4 | O+ | O+ |
| 131 | 16679 | 132 | M | Y | M | 38 | LSCS | 7 | 9 | | 3.2 | A+ | O+ |
| 132 | 14769 | 80 | F | Y | P | 35 | NVD | 7 | 9 | | 2.2 | O+ | O+ |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 133 | 17008 | 49 | F | Y | M | 38 | NVD | 7 | 9 | | 3.2 | AB+ | A+ |
| 134 | 17468 | 73 | F | Y | M | 36 | LSCS | 7 | 9 | | 2.7 | O+ | O+ |
| 135 | 17575 | 62 | M | Y | M | 36 | LSCS | 7 | 8 | | 2.18 | O+ | O+ |
| 136 | 17756 | 54 | F | Y | P | 41 | LSCS | 7 | 9 | | 2.9 | O+ | O+ |
| 137 | 17648 | 74 | M | Y | M | 34 | LSCS | 7 | 9 | | 2.3 | A+ | O+ |
| 138 | 17446 | 73 | F | Y | M | 38 | LSCS | 7 | 9 | | 2.6 | A+ | A+ |
| 139 | 17849 | 84 | F | Y | P | 35 | LSCS | 7 | 9 | | 2.1 | B+ | B+ |
| 140 | 17825 | 63 | M | Y | P | 40 | LSCS | 7 | 9 | | 3.2 | A+ | O+ |
| 141 | 17775 | 70 | M | Y | P | 39 | LSCS | 7 | 9 | | 3.1 | A+ | O+ |
| 142 | 17876 | 54 | M | Y | M | 38 | LSCS | 7 | 9 | | 2.7 | B+ | O+ |
| 143 | 17936 | 60 | F | Y | P | 40 | LSCS | 7 | 9 | | 2.58 | B+ | O+ |
| 144 | 17827 | 72 | M | Y | P | 38 | NVD | 7 | 9 | | 3.1 | O+ | O+ |
| 145 | 17847 | 85 | M | Y | M | 37 | LSCS | 7 | 9 | | 2.67 | A+ | O+ |
| 146 | 18051 | 83 | F | Y | P | 37 | LSCS | 7 | 9 | | 2.5 | B+ | A+ |
| 147 | 17884 | 101 | M | Y | P | 40 | LSCS | 7 | 9 | | 3.5 | O+ | O+ |
| 148 | 18318 | 74 | F | Y | P | 40 | LSCS | 7 | 9 | | 2.55 | B- | O- |
| 149 | 18225 | 75 | F | Y | M | 40 | LSCS | 7 | 9 | | 3.2 | O+ | O+ |
| 150 | 18134 | 95 | F | Y | M | 40 | LSCS | 7 | 9 | | 2.26 | O+ | O+ |
| 151 | 18063 | 99 | M | Y | M | 37 | LSCS | 7 | 9 | | 2.6 | B+ | A+ |
| 152 | 18257 | 55 | M | Y | P | 38 | NVD | 7 | 9 | | 3 | O+ | O+ |
| 153 | 18131 | 113 | F | Y | P | 41 | LSCS | 7 | 9 | | 2.52 | O+ | O+ |
| 154 | 18935 | 108 | M | Y | M | 39 | LSCS | 7 | 9 | | 2.4 | B+ | AB+ |
| 155 | 18958 | 93 | F | Y | P | 40 | LSCS | 7 | 9 | | 2.5 | B+ | O+ |
| 156 | 18959 | 99 | F | Y | P | 40 | LSCS | 7 | 9 | | 2.5 | B+ | O+ |
| 157 | 19225 | 101 | M | Y | P | 38 | LSCS | 7 | 9 | | 2.6 | A+ | A+ |
| 158 | 19110 | 96 | F | Y | M | 38 | LSCS | 7 | 9 | | 3.6 | B+ | O+ |
| 159 | 19371 | 71 | M | Y | P | 38 | NVD | 7 | 9 | | 2.4 | O+ | O+ |
| 160 | 2853 | 120 | F | Y | M | 38 | NVD | 7 | 9 | | 2.5 | B+ | B+ |
| 161 | 19837 | 65 | M | Y | P | 39 | NVD | 7 | 9 | | 3.08 | B+ | A+ |
| 162 | 19681 | 89 | M | Y | P | 39 | NVD | 7 | 9 | | 3.08 | A+ | O+ |
| 163 | 2714 | 120 | F | Y | M | 38 | LSCS | 7 | 9 | | 2.7 | O+ | O+ |
| 164 | 39873 | 72 | M | Y | M | 34 | LSCS | 7 | 9 | TWIN | 2.13 | O+ | O+ |
| 165 | 3960 | 54 | M | Y | P | 40 | LSCS | 7 | 9 | | 2.33 | B+ | A+ |
| 166 | 19935 | 79 | M | Y | M | 35 | NVD | 7 | 9 | | 2 | B+ | A+ |
| 167 | 20212 | 45 | M | Y | M | 40 | NVD | 7 | 9 | | 3.25 | A+ | A+ |
| 168 | 20072 | 80 | M | Y | P | 37 | LSCS | 7 | 9 | | 2.7 | B+ | O+ |
| 169 | 20108 | 78 | M | Y | P | 38 | NVD | 7 | 9 | | 2.34 | B+ | B+ |
| 170 | 20241 | 60 | F | Y | P | 39 | NVD | 7 | 9 | | 2.1 | B+ | B+ |
| 171 | 20440 | 53 | F | Y | P | 42 | LSCS | 7 | 9 | | 3.36 | AB+ | AB+ |
| 172 | 20386 | 66 | F | Y | M | 39 | LSCS | 7 | 9 | | 3.62 | A+ | A+ |
| 173 | 20451 | 49 | F | Y | P | 40 | LSCS | 7 | 9 | | 2.26 | B+ | B+ |
| 174 | 20380 | 93 | F | Y | P | 39 | LSCS | 7 | 9 | | 3.12 | B+ | AB+ |
| 175 | 12846 | 84 | M | Y | P | 38 | LSCS | 7 | 9 | | 2.8 | A+ | AB+ |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 176 | 21032 | 90 | M | Y | P | 40 | LSCS | 7 | 9 | | 2.6 | O+ | O+ |
| 177 | 16998 | 62 | M | Y | P | 38 | NVD | 7 | 9 | | 2.7 | A+ | A+ |
| 178 | 21335 | 31 | M | Y | P | 41 | NVD | 7 | 9 | | 3 | A+ | A+ |
| 179 | 21306 | 81 | F | Y | M | 39 | LSCS | 7 | 9 | | 2.85 | O- | B- |
| 180 | 21471 | 49 | F | Y | P | 40 | NVD | 7 | 9 | | 2.72 | A+ | A+ |
| 181 | 12872 | 99 | F | Y | P | 38 | LSCS | 7 | 9 | PLACENTA PREVIA | 3.15 | A+ | A+ |
| 182 | 22083 | 102 | M | Y | M | 40 | LSCS | 7 | 9 | | 3.2 | B+ | B+ |
| 183 | 21954 | 133 | M | Y | M | 36 | LSCS | 7 | 9 | | 2.48 | B- | AB- |
| 184 | 22320 | 92 | M | Y | P | 40 | LSCS | 7 | 9 | | 2.83 | B+ | B+ |
| 185 | 22768 | 50 | M | Y | P | 38 | LSCS | 7 | 9 | | 2.9 | O+ | O+ |
| 186 | 22775 | 72 | M | Y | M | 40 | NVD | 7 | 9 | | 2.36 | B+ | B+ |
| 187 | 11492 | 166 | M | Y | M | 37 | LSCS | 7 | 9 | | 3 | O+ | O+ |
| 188 | 20503 | 125 | M | Y | M | 36 | LSCS | 7 | 9 | | 2.68 | A+ | A+ |
| 189 | 22742 | 96 | M | Y | P | 37 | LSCS | 7 | 9 | | 3.2 | O+ | O+ |
| 190 | 23007 | 60 | F | Y | M | 38 | LSCS | 7 | 9 | | 2.48 | O+ | O+ |

| SL No | Group | CRP | Total serum bilirubin 0 Hr | 12 Hr | 24Hr | 48Hr | Rate of fall of bilirubin mg/dl/hr | Duration of phototherapy | Duration of hospitalisation | COST |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | CPT | 3 | 14 | 14.2 | 13 | 12 | 0.04 | 33 | 66 | 5000 |
| 2 | IPT | 2 | 13.2 | 12.8 | 11.2 | | 0.08 | 15 | 24 | 2500 |
| 3 | CPT | 1 | 13.7 | 11.6 | | | 0.17 | 18 | 21 | 2500 |
| 4 | IPT | 5 | 11.9 | 11.8 | 10 | | 0.07 | 15 | 24 | 2500 |
| 5 | IPT | 2 | 12.6 | 11 | | | 0.13 | 12 | 23 | 1500 |
| 6 | CPT | 4 | 12.8 | 13 | 11.4 | | 0.05 | 33 | 38 | 2500 |
| 7 | IPT | 6 | 16 | 15.1 | 11.6 | | 0.18 | 21 | 42 | 5000 |
| 8 | IPT | 1 | 16.3 | 14 | 10 | | 0.26 | 21 | 42 | 5000 |
| 9 | CPT | 2 | 13.5 | 10 | | | 0.29 | 15 | 18 | 2500 |
| 10 | CPT | 3 | 16.1 | 14.8 | 11 | | 0.21 | 33 | 40 | 3000 |
| 11 | IPT | 8 | 14.3 | 11 | | | 0.27 | 12 | 24 | 2500 |
| 12 | IPT | 6 | 15.2 | 11 | | | 0.25 | 21 | 39 | 3000 |
| 13 | IPT | 8 | 14 | 12 | | | 0.16 | 12 | 21 | 1500 |
| 14 | IPT | 7 | 15.8 | 11.3 | | | 0.37 | 12 | 24 | 2500 |
| 15 | IPT | 2 | 17 | 15 | 10 | | 0.29 | 27 | 42 | 2500 |
| 16 | IPT | 8 | 13.3 | 12.8 | 9 | | 0.17 | 12 | 24 | 5000 |
| 17 | CPT | 1 | 14.1 | 10.2 | | | 0.32 | 15 | 18 | 2500 |

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|---|---|---|---|---|---|---|---|---|---|---|
| 18 | CPT | 1 | 15 | 11.1 | | | 0.32 | 12 | 15 | 1500 |
| 19 | CPT | 4 | 13.8 | 11.8 | | | 0.16 | 15 | 18 | 2500 |
| 20 | CPT | 6 | 19.1 | 16 | 11.2 | | 0.32 | 30 | 36 | 2500 |
| 21 | IPT | 4 | 16.3 | 14.8 | 10.4 | | 0.24 | 33 | 36 | 4000 |
| 22 | CPT | 6 | 16.6 | 11.1 | | | 0.37 | 36 | 44 | 4000 |
| 23 | IPT | 2 | 14.7 | 12.2 | 9.6 | | 0.21 | 21 | 39 | 3600 |
| 24 | IPT | 8 | 12.1 | 11.2 | 9 | | 0.12 | 15 | 27 | 2500 |
| 25 | CPT | 6 | 12.9 | 12.9 | 10.6 | | 0.95 | 33 | 41 | 3800 |
| 26 | IPT | 7 | 16.6 | 14.2 | 13 | 10 | 0.13 | 24 | 48 | 4000 |
| 27 | CPT | 5 | 15.3 | 13.8 | 9.7 | | 0.22 | 18 | 22 | 2200 |
| 28 | CPT | 3 | 13.4 | 13.6 | 12.7 | 8.7 | 0.09 | 36 | 48 | 4000 |
| 29 | IPT | 1 | 14.3 | 13.5 | 7.4 | | 0.28 | 21 | 39 | 3400 |
| 30 | CPT | 1 | 19.1 | 17 | 13 | 11.5 | 0.15 | 39 | 48 | 4400 |
| 31 | IPT | 2 | 14 | 12.1 | 9.4 | | 0.19 | 12 | 27 | 2600 |
| 32 | CPT | 2 | 13.9 | 11.9 | 9.7 | | 0.17 | 18 | 24 | 2200 |
| 34 | IPT | 2 | 17.8 | 12 | 10.1 | | 0.32 | 12 | 24 | 2500 |
| 35 | IPT | 4 | 14.6 | 12.7 | 11.8 | 9 | 0.11 | 33 | 63 | 5500 |
| 36 | IPT | 3 | 14.8 | 12.6 | 11.5 | 8.2 | 0.13 | 24 | 48 | 4500 |
| 37 | CPT | 2 | 15 | 13.1 | 10 | | 0.2 | 33 | 41 | 4000 |
| 38 | IPT | 8 | 16.3 | 13.8 | 10.4 | | 0.24 | 12 | 24 | 2400 |
| 39 | CPT | 9 | 15.6 | 12.9 | 10.1 | | 0.22 | 27 | 33 | 3500 |
| 40 | CPT | 1 | 15.4 | 12.8 | 11 | | 0.18 | 33 | 40 | 3600 |
| 41 | IPT | 2 | 13.7 | 11.8 | 10.2 | | 0.14 | 21 | 39 | 3500 |
| 42 | IPT | 6 | 14.3 | 11.8 | 10.2 | | 0.17 | 12 | 21 | 2300 |
| 43 | CPT | 1 | 12.6 | 11 | 10.6 | | 0.08 | 18 | 26 | 2400 |
| 44 | CPT | 5 | 16.6 | 15 | 12 | 10.6 | 0.12 | 36 | 48 | 4500 |
| 45 | IPT | 1 | 12.8 | 10.2 | | | 0.2 | 24 | 45 | 4500 |
| 46 | CPT | 2 | 17.2 | 14.6 | 11 | | 0.25 | 21 | 25 | 3000 |
| 47 | IPT | 1 | 15.8 | 14 | 11 | | 0.2 | 12 | 24 | 2000 |
| 48 | CPT | 2 | 11.2 | 9.9 | | | 0.1 | 21 | 25 | 2200 |
| 49 | CPT | 3 | 15.1 | 14 | 11.6 | 10 | 0.1 | 39 | 48 | 4500 |
| 50 | IPT | 1 | 14 | 10.6 | | | 0.38 | 12 | 21 | 2200 |
| 51 | CPT | 2 | 15.2 | 12 | 7.5 | | 0.32 | 33 | 41 | 4500 |
| 52 | IPT | 2 | 17.8 | 15.1 | 10.3 | | 0.31 | 15 | 27 | 3000 |
| 53 | IPT | 6 | 13.6 | 11 | 9 | | 0.19 | 12 | 24 | 2500 |
| 54 | CPT | 4 | 18.6 | 12 | 10 | | 0.35 | 21 | 26 | 2500 |
| 55 | CPT | 2 | 17 | 13 | 10 | | 0.29 | 21 | 26 | 2200 |
| 56 | CPT | 3 | 14.6 | 11.8 | 9 | | 0.23 | 24 | 30 | 2500 |
| 57 | IPT | 8 | 15.9 | 14 | 9.6 | | 0.26 | 12 | 24 | 2500 |
| 58 | IPT | 1 | 15 | 12 | 10 | | 0.2 | 15 | 26 | 2200 |
| 59 | CPT | 1 | 14 | 12 | 9 | | 0.2 | 21 | 26 | 2200 |
| 60 | IPT | 1 | 14.7 | 11.6 | | | 0.25 | 18 | 23 | 2000 |
| 61 | IPT | 2 | 11 | 13.3 | 8.6 | | 0.2 | 21 | 24 | 2200 |
| 62 | CPT | 1 | 13.6 | 9.8 | | | 0.31 | 18 | 22 | 2200 |
| 63 | IPT | 2 | 14.1 | 13.8 | 13 | 9.7 | 0.09 | 24 | 48 | 4000 |
| 64 | CPT | 2 | 16.1 | 15.2 | 14 | 8.4 | 0.16 | 39 | 49 | 4400 |
| 65 | IPT | 2 | 15.5 | 13 | 12 | 8.1 | 0.15 | 21 | 48 | 4000 |
| 66 | IPT | 3 | 14.5 | 11.3 | 8 | | 0.27 | 15 | 27 | 2200 |
| 67 | IPT | 3 | 14.2 | 11 | 9 | | 0.21 | 24 | 46 | 4000 |
| 68 | CPT | 1 | 15.6 | 15.6 | 10 | | 0.04 | 33 | 41 | 4000 |
| 69 | CPT | 2 | 16.4 | 15.4 | 11 | | 0.22 | 30 | 41 | 4000 |
| 70 | CPT | 2 | 14 | 9.9 | | | 0.49 | 15 | 19 | 2000 |
| 71 | CPT | 2 | 14.8 | 10 | | | 0.19 | 18 | 24 | 2000 |
| 72 | IPT | 1 | 13.8 | 11 | 9 | | 0.2 | 15 | 27 | 2200 |
| 73 | CPT | 4 | 19 | 17.4 | 15.5 | 11.9 | 0.14 | 51 | 63 | 5500 |
| 74 | IPT | 2 | 13.8 | 10.8 | | | 0.25 | 12 | 21 | 2200 |
| 75 | IPT | 2 | 17 | 13 | 9 | | 0.29 | 21 | 39 | 3400 |
| 76 | IPT | 7 | 15 | 12 | 9 | | 0.25 | 21 | 26 | 2500 |
| 77 | CPT | 1 | 18.3 | 17.4 | 12 | 9 | 0.21 | 39 | 49 | 4500 |
| 78 | CPT | 2 | 18 | 17.8 | 13 | 10 | 0.16 | 42 | 48 | 4000 |
| 79 | IPT | 1 | 15.7 | 16.2 | 12 | 9 | 0.11 | 24 | 48 | 4000 |
| 80 | IPT | 2 | 14.1 | 13.3 | 10.2 | | 0.16 | 24 | 45 | 4000 |
| 81 | CPT | 2 | 17.5 | 15.5 | 12 | 10 | 0.15 | 42 | 48 | 4500 |
| 82 | CPT | 1 | 14.9 | 11.4 | 9 | | 0.24 | 18 | 26 | 2200 |
| 83 | IPT | 2 | 17.3 | 13.3 | 10 | | 0.3 | 15 | 27 | 2500 |
| 84 | CPT | 4 | 12.3 | 13.2 | 10.3 | | 0.09 | 30 | 38 | 3400 |
| 85 | IPT | 6 | 17 | 15 | 10 | | 0.29 | 18 | 36 | 3800 |
| 86 | IPT | 2 | 15 | 13 | 12.1 | 9.2 | 0.12 | 42 | 70 | 6000 |
| 87 | CPT | 1 | 17 | 17.3 | 13.9 | 10.4 | 0.14 | 51 | 66 | 5500 |
| 88 | IPT | 7 | 14.2 | 13 | 8.5 | | 0.23 | 21 | 39 | 3600 |
| 89 | CPT | 3 | 14.9 | 12 | 9 | | 0.2 | 33 | 40 | 4000 |
| 90 | IPT | 1 | 15 | 11.4 | 8 | | 0.29 | 24 | 45 | 4000 |
| 91 | CPT | 6 | 17 | 15 | 12.2 | 10 | 0.14 | 48 | 60 | 5200 |
| 92 | IPT | 1 | 16.1 | 16.1 | 10 | | 0.24 | 21 | 42 | 4000 |
| 93 | CPT | 4 | 13.6 | 11.9 | 9 | | 0.19 | 21 | 26 | 2200 |
| 94 | IPT | 1 | 16.4 | 16 | 11 | | 0.22 | 21 | 42 | 4200 |
| 95 | IPT | 2 | 15.9 | 12 | 10 | | 0.24 | 21 | 41 | 3600 |
| 96 | CPT | 2 | 19.8 | 15 | 11.1 | | 0.36 | 33 | 41 | 4500 |
| 97 | IPT | 2 | 16.1 | 14 | 10 | | 0.25 | 15 | 26 | 2200 |
| 98 | CPT | 1 | 16.8 | 14 | 11 | | 0.24 | 21 | 26 | 2200 |
| 99 | IPT | 4 | 13.7 | 9 | | | 0.19 | 12 | 21 | 2200 |

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|---|---|---|---|---|---|---|---|---|---|---|
| 100 | CPT | 3 | 14 | 11 | | | 0.25 | 12 | 15 | 1500 |
| 101 | IPT | 1 | 14 | 9 | | | 0.4 | 12 | 21 | 2000 |
| 102 | CPT | 2 | 18.7 | 17.5 | 14 | 10 | 0.18 | 36 | 48 | 4000 |
| 103 | IPT | 1 | 17.3 | 13.8 | 8.2 | | 0.29 | 21 | 39 | 4000 |
| 104 | IPT | 2 | 16.2 | 14.2 | 10 | | 0.25 | 21 | 39 | 4000 |
| 105 | IPT | 4 | 18 | 11 | | | 0.5 | 12 | 21 | 2200 |
| 106 | IPT | 2 | 19.4 | 14 | 10 | | 0.39 | 18 | 39 | 4000 |
| 107 | CPT | 2 | 19.6 | 14 | 10.6 | | 0.41 | 33 | 42 | 4000 |
| 108 | CPT | 1 | 13.8 | 11 | 9 | | 0.2 | 18 | 24 | 2200 |
| 109 | CPT | 1 | 19.2 | 16.3 | 10.6 | | 0.38 | 21 | 26 | 2200 |
| 110 | CPT | 2 | 15.7 | 12.7 | 10 | | 0.23 | 18 | 22 | 2200 |
| 111 | CPT | 3 | 15.5 | 10.2 | | | 0.44 | 12 | 15 | 2000 |
| 112 | CPT | 2 | 18.1 | 16.7 | 12.9 | 10 | 0.16 | 39 | 51 | 4400 |
| 113 | IPT | 6 | 12.9 | 10.9 | 7 | | 0.24 | 15 | 24 | 2200 |
| 114 | IPT | 6 | 14.4 | 11 | 8.1 | | 0.26 | 12 | 24 | 2200 |
| 115 | IPT | 2 | 16.5 | 11 | 8 | | 0.35 | 18 | 36 | 3800 |
| 116 | CPT | 3 | 20.4 | 16 | 11.1 | | 0.38 | 24 | 30 | 3800 |
| 117 | CPT | 4 | 16 | 12.8 | 9.1 | | 0.28 | 18 | 26 | 2200 |
| 118 | CPT | 8 | 14.9 | 15 | 10 | | 0.2 | 33 | 37 | 3600 |
| 119 | CPT | 3 | 14.5 | 10 | | | 0.37 | 15 | 18 | 2000 |
| 120 | IPT | 7 | 15.2 | 13.4 | 10 | | 0.21 | 21 | 39 | 4000 |
| 121 | IPT | 6 | 14.4 | 11.2 | 8 | | 0.2 | 12 | 24 | 2200 |
| 122 | IPT | 4 | 13.8 | 11.2 | 9 | | 0.2 | 21 | 39 | 4000 |
| 123 | CPT | 8 | 17.7 | 13 | 10.2 | | 0.31 | 18 | 25 | 2200 |
| 124 | IPT | 4 | 15.6 | 12.3 | 10.1 | | 0.22 | 12 | 24 | 2200 |
| 125 | CPT | 1 | 13.6 | 8.9 | | | 0.39 | 12 | 14 | 2200 |
| 126 | IPT | 5 | 15.3 | 14.5 | 12 | 8.7 | 0.13 | 21 | 63 | 5500 |
| 127 | CPT | 7 | 14.5 | 12.4 | 9.1 | | 0.11 | 27 | 35 | 4000 |
| 128 | CPT | 3 | 12.8 | 14.2 | 13.2 | 9.4 | 0.07 | 57 | 72 | 6600 |
| 129 | IPT | 1 | 12.3 | 11 | 8 | | 0.17 | 18 | 36 | 3600 |
| 130 | IPT | 2 | 14 | 12.1 | 8.4 | | 0.23 | 12 | 24 | 2200 |
| 131 | CPT | 3 | 15.7 | 12 | 8.2 | | 0.15 | 21 | 26 | 2500 |
| 132 | CPT | 3 | 15.9 | 12 | 9 | | 0.28 | 36 | 44 | 4000 |
| 133 | IPT | 3 | 12.1 | 11 | 8 | | 0.17 | 15 | 30 | 2500 |
| 134 | IPT | 2 | 14.2 | 11.8 | 10 | | 0.17 | 21 | 42 | 4000 |
| 135 | IPT | 2 | 14.1 | 12.5 | 8.2 | | 0.24 | 21 | 42 | 4000 |
| 136 | IPT | 3 | 15.3 | 12 | 9.6 | | 0.1 | 12 | 24 | 2200 |
| 137 | IPT | 1 | 16.6 | 12.2 | 10 | | 0.09 | 21 | 42 | 4000 |
| 138 | CPT | 2 | 17.1 | 15.2 | 11.6 | | 0.15 | 33 | 41 | 4000 |
| 139 | IPT | 7 | 13.7 | 15.6 | 12 | | 0.07 | 21 | 26 | 2200 |
| 140 | CPT | 4 | 16 | 14.2 | 13.6 | 11 | 0.1 | 54 | 67 | 6000 |
| 141 | CPT | 6 | 15.6 | 13.3 | 12.6 | 10 | 0.11 | 54 | 67 | 6000 |
| 142 | IPT | 2 | 17.6 | 15 | 21.1 | 9 | 0.17 | 33 | 66 | 6000 |
| 143 | IPT | 3 | 16.8 | 14.4 | 10.1 | | 0.27 | 18 | 36 | 3600 |
| 144 | CPT | 4 | 17 | 15.5 | 9.9 | | 0.29 | 33 | 42 | 4500 |
| 145 | IPT | 2 | 14.8 | 12 | 11 | | 0.15 | 12 | 18 | 2000 |
| 146 | IPT | 5 | 14 | 12.4 | 10 | | 0.16 | 21 | 42 | 4500 |
| 147 | CPT | 3 | 14 | 12.4 | 9.8 | | 0.17 | 18 | 23 | 2500 |
| 148 | CPT | 4 | 15.1 | 12 | 9 | | 0.25 | 24 | 29 | 2500 |
| 149 | CPT | 2 | 13.4 | 10.1 | | | 0.1 | 12 | 15 | 2000 |
| 150 | IPT | 1 | 13.6 | 12.2 | 11.4 | | 0.09 | 24 | 45 | 4500 |
| 151 | IPT | 8 | 13.7 | 12.1 | 9.6 | | 0.17 | 12 | 24 | 2500 |
| 152 | CPT | 7 | 17.8 | 18.2 | 15.6 | 10.4 | 0.15 | 39 | 48 | 4500 |
| 153 | CPT | 4 | 13.6 | 9.9 | | | 0.3 | 15 | 20 | 2200 |
| 154 | CPT | 4 | 13.6 | 10.1 | | | 0.29 | 15 | 18 | 2200 |
| 155 | CPT | 4.5 | 20.7 | 16.1 | 11.2 | | 0.39 | 33 | 41 | 4600 |
| 156 | CPT | 5 | 20.7 | 18.8 | 11.3 | 10.1 | 0.22 | 54 | 66 | 5000 |
| 157 | IPT | 2 | 15.1 | 13 | 11 | | 0.17 | 12 | 24 | 2200 |
| 158 | IPT | 1 | 16.4 | 15.9 | 12.4 | 10.2 | 0.12 | 24 | 48 | 4200 |
| 159 | IPT | 7 | 13.8 | 11.8 | 9.4 | | 0.18 | 15 | 27 | 2500 |
| 160 | IPT | 1 | 18.1 | 15 | 11 | | 0.3 | 18 | 33 | 3400 |
| 161 | CPT | 3 | 12.8 | 10.9 | 8.8 | | 0.16 | 21 | 25 | 2500 |
| 162 | CPT | 4 | 13.3 | 9.8 | | | 0.29 | 18 | 22 | 2200 |
| 163 | IPT | 1 | 16 | 12 | 9 | | 0.3 | 18 | 32 | 2800 |
| 164 | IPT | 4 | 16 | 12 | 8.1 | | 0.3 | 16 | 24 | 2200 |
| 165 | CPT | 1 | 16 | 15.5 | 7.8 | | 0.34 | 33 | 44 | 4000 |
| 166 | IPT | 1 | 16.7 | 14 | 11 | | 0.23 | 21 | 42 | 4000 |
| 167 | IPT | 3 | 14.4 | 12 | 10 | | 0.18 | 15 | 24 | 2200 |
| 168 | CPT | 2 | 14.6 | 12.1 | 9.7 | | 0.2 | 21 | 25 | 2200 |
| 169 | CPT | 4 | 19.3 | 15.5 | 12.1 | 10.9 | 0.17 | 51 | 64 | 5000 |
| 170 | IPT | 1 | 11.2 | 9 | | | 0.18 | 12 | 21 | 2000 |
| 171 | IPT | 4 | 11.6 | 10.8 | 8 | | 0.15 | 21 | 39 | 4000 |
| 172 | IPT | 7 | 18.6 | 15 | 12.1 | 9 | 0.2 | 24 | 48 | 4500 |
| 173 | IPT | 6 | 15.9 | 12 | 9.1 | | 0.28 | 24 | 45 | 4500 |
| 174 | IPT | 7 | 15.3 | 11.9 | 8.9 | | 0.26 | 12 | 24 | 2600 |
| 175 | CPT | 3 | 14.5 | 14.2 | 9 | | 0.22 | 36 | 41 | 4000 |
| 176 | CPT | 3 | 16.7 | 14.2 | 10.8 | | 0.24 | 21 | 25 | 2600 |
| 177 | CPT | 1 | 11.9 | 8.4 | | | 0.29 | 21 | 23 | 2000 |
| 178 | CPT | 5 | 12.7 | 9.1 | | | 0.3 | 12 | 15 | 1500 |
| 179 | IPT | 4 | 14.4 | 10.1 | | | 0.35 | 12 | 21 | 2000 |
| 180 | CPT | 8 | 12.4 | 13.6 | 10.8 | | 0.06 | 33 | 41 | 4000 |

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|---|---|---|---|---|---|---|---|---|---|---|
| 181 | IPT | 2 | 15 | 11 | | | 0.33 | 15 | 27 | 2500 |
| 182 | IPT | 2 | 16.8 | 15.3 | 11 | | 0.24 | 21 | 42 | 4000 |
| 183 | IPT | 2 | 15 | 13.1 | 10 | | 0.2 | 21 | 42 | 4000 |
| 184 | CPT | 6 | 16.7 | 15.1 | 11 | | 0.23 | 33 | 40 | 4000 |
| 185 | IPT | 3 | 13.6 | 14 | 9.9 | | 0.15 | 21 | 42 | 4200 |
| 186 | CPT | 5 | 16.2 | 13.8 | 10 | | 0.25 | 21 | 25 | 3000 |
| 187 | IPT | 2 | 19.5 | 15 | 11 | | 0.35 | 15 | 25 | 2200 |
| 188 | CPT | 4 | 14.3 | 12.9 | 9.1 | | 0.21 | 21 | 49 | 4800 |
| 189 | CPT | 4 | 18.1 | 13.4 | 10.1 | | 0.33 | 36 | 43 | 4200 |
| 190 | CPT | 2 | 17.8 | 16 | 12.1 | 9.2 | 0.17 | 39 | 48 | 4500 |