MEDICAL LIGHT AND COMBATING OF HYPERBILIRUBINEMIA

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References Cited

UNITED STATES PATENTS

ABSTRACT

A medical light especially useful in combating hyperbilirubinemia of neonates. The light comprises a neon bulb mounted in a housing of size and construction such that the light can be placed in an incubator.

29 Claims, 2 Drawing Figures
FIG. 1.

BILIRUBIN LIGHT

120V.-3000V. TRANSFORMER

VOLTAGE REGULATOR
FIG. 2.
MEDICAL LIGHT AND COMBATING OF HYPERBILIRUBINEMIA

BACKGROUND

Radiation in the visible spectrum range has become recognized as a treatment, both therapeutically and prophylactically, for hyperbilirubinemia. Blue light is generally regarded as the most effective.

Floor lamps outfitted with fluorescent bulbs are commonly used. A housing, containing, e.g., 8 to 10, fluorescent bulbs in a planeparallel array, is mounted on a floor stand. The height of the housing can be adjustable. In use the lamps are disposed with the light housing positioned outside and over an incubator, which is outfitted with a transparent top cover, for radiation through the incubator cover to the infant's body. A filter for light of wave length shorter than that of blue can be provided. Thereby ultra-violet radiation, which is generally considered to be undesirable, can be eliminated.

The mentioned prior art practice is accompanied by several disadvantages.

Light spillage or the proportion of the radiation not striking the infant's body is high.

It is necessary to mask the infant's head to prevent harmful effects accompanying radiation of that part of the body. In practice, masking is done by wrapping the baby's head, including the eyes, in bandages.

Another disadvantage is that the light tends to heat up the incubator.

Further, the energy output of the fluorescent bulbs decreases with use. The decrease in radiation of blue light of wavelength 400 to 480 nm (nanometers) is reported to be as high as 44 percent in 200 hours. Treatment periods are, for example, 48 to 144 hours.

Another disadvantage, when the preferred blue light is used, is that in order to periodically check the color of the infant's skin to determine, e.g., the occurrence of cyanosis, it is necessary to temporarily turn the light off. A development of undesirable coloration of the skin may not be observable unless the nurse turns the light off, so that even given a procedure whereby color is to be periodically check, injury may occur in the event checking is inadvertently omitted.

Also, blue light may cause nausea so that the nursing staff may be bothered by the treatment.

Still another disadvantage is that the floor stand, fluorescent lamps are awkward to use. They are bulky and inconvenient to move about. To regulate intensity of radiation, the height of the light housing is adjusted, or the bulbs are changed.

Numerous other constructions for medical lights have been proposed. Ruiter, U.S. Pat. No. 1,337,798, discloses a housing outfitted with lights for receiving a part of the truck of a patient. Ries et al., U.S. Pat. No. 2,300,008, disclose a neon light for placement on parts of the body. Bacon, U.S. Pat. No. 2,003,527 discloses a light adapted to be moved over the body.

Additionally, Hess, U.S. Pat. No. 1,900,342, discloses an incubator for infants outfitted with a therapeutic light.

None of the mentioned prior art lights are suitable for the purposes which are the concern of the instant application.

THE INVENTION

The invention provides for treatment of hyperbilirubinemia of neonates unaccompanied by the aforementioned disadvantages of the prior art practices. According to the invention, the infant is treated by directing radiation of a neon light onto the infant for a time sufficient to counteract hyperbilirubinemia. It is particularly contemplated that the infant be in an incubator during the treatment, with the neon light positioned within the incubator.

The light comprises a housing opened at the bottom and at one end thereof for placement of the housing over the infant without the housing and the trunk covered by the housing. A neon light is mounted within the upper part of the housing for directing of emitted light to the trunk of the infant. The light includes a shield mounted on the end adjacent the infant's head, for shielding the infant's head from the emitted light.

Preferably, the light emits radiation in the blue portion of the visible spectrum, and filter means are provided for absorption of ultra-violet radiation before transmission of the light to the infant.

The housing can have closed sides, which can be transparent, or, if desired, the inner surface of the sides can be reflecting for inward reflection of radiation to the infant.

The end of the housing opposite the head end can be opened for disposition of the infant's legs, at least partially, without the housing. Also, the housing can be of such dimensions that the infant's arms can be disposed without the housing.

With reference to the foregoing discussion of disadvantages of the floor stand, fluorescent lights commonly used for hyperbilirubinemia, the lamp of the instant application provides substantial reduction in light spillage. Also, masking of the infant's head is not necessary as the shield provided with the lamp prevents radiation striking the infant's head. By reason of the character of the neon light, undesirable heating up does not occur. Also, reduction in light intensity with use does not occur to an objectionable extent. To avoid loss in intensity with use, the neon lamp can be aged for 100 hours before delivery. Thereafter, loss in footcandles is not over about 10 percent in 5 years. Observing coloration is not a problem, since the portions of the infant's body disposed without the light housing, are always observable. Further, intensity of the radiation can be conveniently controlled by use of a voltage regulator. Then too, the lamp of the invention admits of a construction of a high degree of safety, while at the same time being convenient to use and store.

EMBODIMENT

The invention is illustrated in the accompanying drawings wherein:

FIG. 1 is a perspective view of a medical light according to the invention, including a schematic illustration of the power supply for the light; and

FIG. 2 is an end view from the head end, taken along 2-2 in FIG. 1.

According to the invention, the medical light 1 includes a housing 2 composed of a closed top 3, closed sides 11, foot end 4 having an opening 6 for projection therefrom of an infant's legs, and head end 5 which is open to permit projection of the infant's head from the
The opening 8 in the head end 5 is an inverted U-shaped opening formed in a plate 9 which is slidably mounted on the head end 5 by way of guides 10 so that the plate can be manually moved up and down. The overall size of the medical light, in inches, can be $8 \times 8 \times 8$ to $12 \times 12 \times 12$, preferably $9 \times 9 \times 9$ to $11 \times 11 \times 11$. A height of 9% inches and a length and width of 10 inches has been found to be particularly well suited. The light is sized so that it can fit within an incubator, i.e., within the incubator with the incubator top cover in place. The lamp is light weight and can be easily moved about by members of the nursing staff. A handle 7, (FIG. 2), is provided for the unit. The light, however, is sufficiently heavy so that it resists movement by the infant.

The top 3 and the upper portion 11a of the housing can be and preferably is opaque so that light is not transmitted therethrough. The lower portion 11b of the sides can be transparent or opaque. Also, it can have an inner surface which is reflecting so that radiation is reflected toward the infant. Desirably the lower portion of the sides is amber plastic, e.g., Plexiglas which does not transmit radiation in the range of 400 – 500 nm, i.e., blue light. The head end and the foot end of the housing can be of the same construction as is mentioned for the sides.

The neon light comprising the tubing 12 and electrode caps 14, rest on support bars 13 in the upper portion of the housing. Air vent holes 18 are provided in the upper portion of the housing to prevent any undesirable heat build up.

The tubing 12 can be 9 mm id, 6 feet in length. The tubing can be Corning G-1 lead glass, non-ultra-violet emitting, filled with a noble gas, e.g., argon, and can be coated with fluorescent lamp phosphor, so that the lamp will preferentially emit blue light, e.g., radiation of wave length in the range of 400 – 500 nm, preferably in the range of 425 – 475 nm. The ends of the tubing are connected with power leads from the cable 15, via electrode caps 14. Preferably, the contents of the tubing are non-toxic, and free of mercury. Desirably, a pure noble gas is used, e.g., pure argon. Then breakage would not contaminate the incubator.

Desirably, means are provided in the upper portion of the housing, below the neon light tubing, for absorption of ultraviolet radiation. Thus, Plexiglas plate 17 is positioned between the upper portion 11a and the lower portion 11b of the sidewalls. The plate can be UVA B plexiglass of Rohm and Hass, ½ inch thick.

The power supply is indicated in FIG. 1. A neon light transformer, for transforming 120V supply to 3,000 – 4,000 output is used. Cable 23, including a voltage regulator 22 is provided for connection to the 120V supply. The power unit includes an on-off switch 25, and an indicator light 24. A safety plug 21, which is a four contact CPH No. 49,638 plug, is provided for connecting cable 15 to the power supply. The safety plug insures that the high voltage side of the transformer will be closed, before closing of the low voltage power input side. The output of the neon light can be controlled by the voltage regulator 22, so that a selected degree of radiation can be utilized. The current of the output side of the transformer can be about 30 milliamps.

While the invention has been described with respect to particular embodiments thereof, those embodiments are merely representative and do not represent the boundaries of the invention.

What is claimed is:

1. A medical light suitable for placement in an infant incubator with the incubator top cover in place comprising:
   a. a housing open at one end thereof for housing the infant with the trunk within the housing and the head without the housing, outside of said opening,
   b. a neon light mounted within the upper part of the housing for directing of emitted light to the trunk of the infant with the housing placed as aforesaid,
   c. a shield mounted on said one end of the housing for shielding the infant's head from the light emitted from the neon light.

2. Medical light according to claim 1, the medical light emitting radiation in the blue portion of the visible spectrum to the trunk of the infant.

3. Medical light according to claim 2, and a filter means for absorption of ultra-violet radiation before transmission of the light to the infant.

4. Medical light according to claim 3, said shield comprising a plate having an inverted U-shaped opening providing said open end for the infant's head, said plate being slidably mounted on the housing for up and down movement.

5. Medical light according to claim 1, and a filter means for absorption of ultra-violet radiation before transmission of the light to the infant.

6. Medical light according to claim 1, having closed sides, the inner surface of the sides being reflecting for inward reflection of radiation to the infant.

7. Medical light according to claim 1, the other end of the housing being open for disposition of the infant's legs at least partially without the housing.

8. Medical light according to claim 7, the housing having closed sides, the inner surface of the sides being reflecting for inward reflection of radiation to the infant, the light emitting radiation in the blue portion of the visible spectrum, and a filter means for absorption of ultra-violet radiation before transmission of the light to the infant.

9. Medical light according to claim 8, said shield comprising a plate having an inverted U-shaped opening providing said open end for the infant's head, said plate being slidably mounted on the housing for up and down movement.

10. Medical light according to claim 9, and an electrical transformer having the high voltage side thereof connected to the neon light, and a voltage regulator connected to the transformer for controlling the intensity of the light.

11. Medical light according to claim 1, having closed sides, the lower portion of the sides being formed of amber plastic which does not transmit blue light.

12. Medical light according to claim 11, the medical light preferentially emitting blue light to the trunk of the infant.

13. Medical light according to claim 12, the blue light being radiation of wave length in the range of 400–500 nm.

14. Medical light according to claim 3, having closed sides, the lower portion of the sides being formed of amber plastic which does not transmit blue light.
15. Medical light according to claim 14, and a neon light transformer connected to the medical light by an extension cord.

16. Medical light according to claim 15, the overall size of the light being 8 × 8 × 8 to 12 × 12 × 12, the neon light comprising tubing filled with a noble gas and coated with fluorescent lamp phosphor.

17. Medical light according to claim 16, the phosphor preferentially emitting blue light.

18. Medical light according to claim 17, the blue light being radiation of wavelength in the range of 400–500 nm.

19. Medical light according to claim 1, and a neon light transformer connected to the medical light by an extension cord.

20. Medical light according to claim 3, the overall size of the light being 8 × 8 × 8 to 12 × 12 × 12.

21. Medical light according to claim 3, the neon light comprising tubing filled with a noble gas and coated with fluorescent lamp phosphor.

22. Method of combating hyperbilirubinemia of neonates which comprises directing radiation of a medical light onto the infant in an incubator for a time sufficient to counteract hyperbilirubinemia, the medical light being disposed within the incubator with the incubator top cover in place, the medical light comprising:

a. a housing open at one end thereof housing the infant with the trunk within the housing and the head without the housing outside of said opening,

b. a neon light mounted within the upper part of the housing directing emitted light to the trunk of the infant with the housing placed as aforesaid,

c. a shield mounted on said one end of the housing shielding the infant's head from the light emitted from the neon light.

23. Method according to claim 22, the medical light emitting radiation in the blue portion of the visible spectrum to the trunk of the infant for said combating of hyperbilirubinemia.

24. Medical light according to claim 1, the medical light preferentially emitting blue light to the trunk of the infant.

25. Medical light according to claim 24, the blue light being radiation of wavelength in the range of 400–500 nm.

26. Medical light according to claim 3, the medical light preferentially emitting blue light to the trunk of the infant.

27. Medical light according to claim 26, the blue light being radiation of wavelength in the range of 400–500 nm.

28. Medical light according to claim 21, the phosphor preferentially emitting blue light.

29. Medical light according to claim 28, the blue light being radiation of wavelength in the range of 400–500 nm.