

Double surface phototherapy on a fluid bed

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Summary Jaundice is a common neonatal problem with a higher incidence in premature infants. Phototherapy is an established treatment modality, effective and safer than exchange transfusion. Double surface phototherapy is more effective. The present methods have drawbacks, viz limited availability, high cost of equipment and difficulties in nursing infants during phototherapy. A modification to the technique which overcomes these difficulties made with equipment available in most neonatal units is described with three case reports of hyperbilirubinaemia successfully treated using this method.

Introduction

Jaundice is a common problem of neonates. Over 9% of healthy, term babies develop hyperbilirubinaemia with levels $> 255 \mu\text{mol/l}$ (15 mg/dl).¹ The incidence is higher in premature infants.² Unconjugated bilirubin is toxic and causes kernicterus. Exchange transfusion is an effective treatment but can cause death and other complications.³

Phototherapy has been used since 1958. It is effective and safe, and is used in neonatal units all over the world. Unclothed jaundiced infants are exposed to light of optimum wavelength and intensity. The rate of degradation reaches 'saturation point', beyond which increases in light dosage have no further beneficial effects.⁴ The 'saturation point' can be reached by the method described by Tan.^{5,6} The infant lies in a transparent cot, and is exposed to blue light (wavelength 470 nm⁷) from above and below in a purpose-built phototherapy unit.⁸ The method is effective.

However, the following drawbacks are noted. It requires a purpose-built phototherapy unit, the unclothed infant lies on a hard plastic surface, significant temperature changes occur and increased handling of the infant is necessary following micturition.

Recently available fiberoptic blankets are effective^{9,10} but are expensive and not widely available.

We describe a modification to the equipment available in our neonatal units which overcomes these disadvantages and provides higher irradiance.

Materials and methods

Two phototherapy units (Air Shield, Narco Scientific), each with four blue fluorescent lamps, F2OT12/BB, are used. The infant is nursed unclothed with a disposable diaper cut to minimum effective size, held in place with cling film. The eyes are covered. The top light unit for use as a radiant heater is placed at an angle and slightly to one side for easy accessibility to the infant. The bottom light unit is

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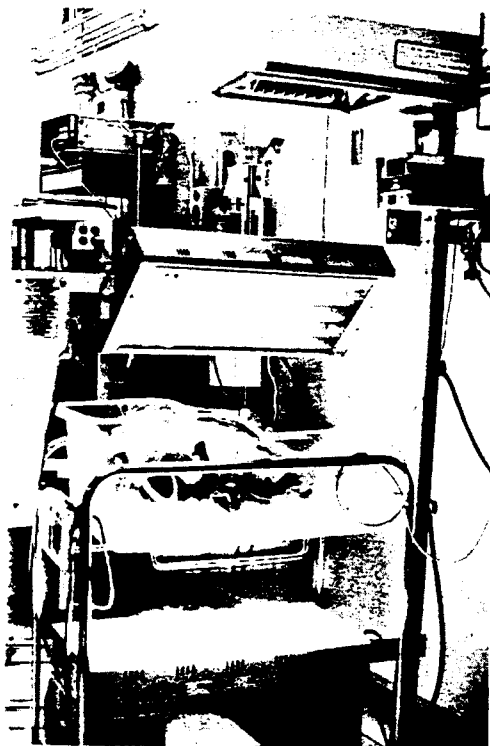


FIG. 1. Relative position of phototherapy units and radiant warmer to the infant.

placed approximately 40 cm below the bassinet.

The fluid bed is made up of five, 1-litre saline or other fluid bags made of clear plastic. Five hundred ml of fluid are removed from each bag. The bags are placed parallel and held in place by two strips of clear tape (Fig. 1). The bag wall with the manufacturer's inscription is kept away from the baby.

A servo control radiant heater is used to maintain the infant's temperature. The fluid bed acts as a thermal reservoir and helps maintain uniform temperature. The fluid bed is warmed from ambient temperature to nursing temperature by immersing the bags in warm water prior to commencing phototherapy.

A urine bag is used with a feeding tube to drain the urine periodically. This aids nursing, reducing the handling of the baby following micturition.

Transparent cling film partially covers the

cot to minimize heat loss in the infants < 1500 g.

The irradiance of the light passing through the fluid-filled bag is 9–12 $\text{uw/cm}^2 \text{ nm}$. It is checked by a Photoradiometer PR III (Narco) Air Shield with maximum sensitivity at the wavelength of 470 nm. The fluid bed causes no detectable loss of light intensity.

During sampling, we found the following temperatures: ambient room: 26°C, cot (surface): 27–29°C, fluid bed: 33–34.9°C, infant skin: 36.5–37.2°C.

Case reports

1. A full term boy weighing 3.6 kg developed hyperbilirubinaemia within 12 hours of birth. Serum bilirubin (SBR) was 170 μmol (10 mg/dl), indicating spherocytosis. Phototherapy was started with light units illuminating the same area of skin. The SBR increased to 370 $\mu\text{mol/l}$ (21.7 mg/dl) by 36 hours of age.

Exchange transfusion was considered but double surface phototherapy on the waterbed was commenced. The rise in bilirubin level was controlled with an initial plateau and then decline in the level over 24 hrs to SBR 292 $\mu\text{mol/l}$ (17.1 mg/dl). The infant was then returned to conventional phototherapy and nursing.

2. A preterm boy weighing 1.1 kg and of 30 weeks gestation on respiratory support developed hyperbilirubinaemia at 48 hrs of age; SBR was 140 $\mu\text{mol/l}$ (8.2 mg/dl). Single phototherapy was commenced. The SBR continued to rise, reaching 258 $\mu\text{mol/l}$ (15.1 mg/dl) by 72 hrs. Double surface phototherapy was commenced with a satisfactory decline in the rate of rise followed by a fall in the SBR level to 198 $\mu\text{mol/l}$ (11.6 mg/dl). The infant was returned to conventional nursing and phototherapy after 28 hrs. The temperature was satisfactory during the phototherapy.

3. A full term girl of 2.8 kg had developed hyperbilirubinaemia by 20 hrs of age with the SBR 247 $\mu\text{mol/l}$ (14.5 mg/dl). Infant and mother were both A + ve blood group. The Coomb's test was positive. The infant was commenced on conventional single phototherapy with a rise in the SBR to 293 $\mu\text{mol/l}$ (17.2 mg/dl) at age 26 hours. Double surface phototherapy was commenced with a decline in the SBR to 263 $\mu\text{mol/l}$ (15.4 mg/dl) by 32 hrs. The infant was returned to conventional phototherapy after 24 hours of double surface phototherapy.

Discussion

Our case reports illustrate the use and efficacy of double surface phototherapy on a fluid bed. It is more effective than single conventional phototherapy because during the course of treatment each baby is his own control. Turning the infant regularly under conventional phototherapy does not alter the rate of decline of the SBR.¹¹ There were no problems with temperature regulation, nursing and monitoring of the infants during double surface phototherapy.

Double surface phototherapy is more effective than conventional single phototherapy in the treatment of neonatal hyperbilirubinaemia.^{6,9,10} The method described enables double surface phototherapy to be provided in most neonatal units. The minor modifications to the equipment can be done easily and are reversible. There is no initial capital expenditure on new equipment. The maintenance is minimal with readily available accessories. This is an important factor in most developing countries.

This method provides an easily available alternative to the fibreoptic system as a mode of more effective phototherapy. It will assist in the care of the jaundiced newborn and decrease the need for exchange transfusion and the use of blood products in the management of hyperbilirubinaemia.

Further work is required to demonstrate the efficacy and safety of this method of delivering higher intensity light, which may further improve the efficacy of phototherapy during critical periods of hyperbilirubinaemia in the ill neonate.

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