Optimal thermal environment in a neonatal cot

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Abstract

Objective To determine the correct wattage of electric bulbs which will give optimal temperature to neonates in standard neonatal cots provided by the family health bureau.

Design Experimental study.

Method Bulbs of different wattage were fixed to the neonatal cots. The temperatures inside the cots were determined over a period of time with a thermometer. This procedure was repeated at different room temperatures. The room temperature was changed using an air conditioner.

Results The wattage of electric bulbs that gave the optimum temperature for neonates and the rapidity of temperature rise differed at different room temperatures.

Conclusions

- The ideal room temperature of a neonatal unit should be 25-30°C.
- The wattage of the electric bulb that is fixed to the cot has to be chosen according to the environmental temperature and the weight of the neonate.
- Before placing a neonate in the cot the bulb has to be switched on for at least 30 minutes to achieve a stable temperature inside the cot.
- Even with a 100w bulb an optimal thermal environment cannot be achieved during the first 3 days if the room temperature is 20°C or below.

Introduction

In many neonatal units of Sri Lanka, cots with a plastic box are used to keep the neonates warm. These steel cots are manufactured in Sri Lanka. The box of this cot is made of perspex which is a brand of plastic. The plastic shields are kept together with an aluminium frame and over the cot there is a lamp into which an ordinary electric bulb could be fixed. In the earlier versions of this cot there was no protective covering in front of the bulb but the newer cots have a protective mesh. This is an excellent example of local technology being used to provide care to neonates at a lower cost. Attempts of this nature have to be commended as we do not have adequate funds to keep the entire environment of a neonatal unit at an optimal level by central heating or to provide incubators to all neonates.

These cots are provided by the Family Health Bureau of the Ministry of Health to neonatal units. However, unlike in the case of other medical equipment, an instruction manual is not given with these cots. This has resulted in many units using electric bulbs of varying wattage in these cots or no bulb at all. However, the basic concept of optimal neonatal thermal environment has to be adhered to, if these cots are used to keep the neonates warm.

Material and methods

An experimental study was carried out at the Base Hospital, Hambantota to determine the correct wattage of electric bulb which would give the optimum temperature to neonates in these cots. First the optimal thermal environment for neonates was identified. Table 1 gives the neutral thermal environment during the first 3 days for different birth weights[1,2]. Table 2 gives the neutral thermal environment after the first 3 days[3].

As in many cots the minimum distance between the cot sheet and the bulb was 40 cm, the temperature inside the cot was assumed to vary according to three factors:

- Temperature of the environment.
- Wattage of the electric bulb.
- Duration the electric bulb was switched on.

These cots are used in neonatal units in different parts of Sri Lanka which have a wide variation in environmental temperature. For instance, in Nuwaraeliya the environmental temperature may go down to 8°C and at Hambantota it may go up to 34°C

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Table 1
Neutral thermal environment during first three days

Birth weight (g)	*Temperature (°C)*
1000	35
1500	34
2000	33.5
2500	33.2
3000	33
4000	32.5

Table 2
Neutral thermal environment after first three days

Birth weight (g)	*Temperature (°C)*
1000-1500	34
1501-2000	32
2001-2500	30
>2500	28

WHO/FHE/MSM 93.2 (1992)

After Scopes & Ahmed (1966) and Hey & Katz (1970)

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Table 3
Recommended wattage of the bulb to be used in neonates of different birth weights at given room temperatures

Weight of neonate	*Room temperature during first three days of life*			*Room temperature after three days of life*		
.	**30°C**	**25°C**	**20°C**	**30°C**	**25°C**	**20°C**
1000-1500g	100w	NE	NE	75w	100w	NE
1501-2000g	75w	100w	NE	60w	75w	NE
2001-2500g	75w	100w	NE	40w	60w	100w
2501-3000g	75w	100w	NE	25w	25w	75w
3001-4000g	60w	100w	NE	25w	25w	75w

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NE - Not effective

To ascertain the wattage of the bulb that would give the optimal thermal environment inside the cot, bulbs of 5 different wattage i.e. 25w, 40w, 60w, 75w, 100w were placed in the lamp during the experiment. The rapidity of temperature rise at 3 different environmental temperatures i.e. 30°C, 25°C, 20°C were checked using a sensitive mercury thermometer at 10 minute intervals (Table 3). As this experiment was carried out at Base Hospital, Hambantota an air conditioner was used to bring down the temperature to 20°C. At the end of the experiment it was considered not necessary to bring down the temperature below 20°C.

Results

The temperature inside the neonatal cot was measured at three different room temperatures i.e. 30°C, 25°C, 20°C and plotted in a chart against time with electric bulbs of 5 different wattage. The findings are shown in Figure 1.

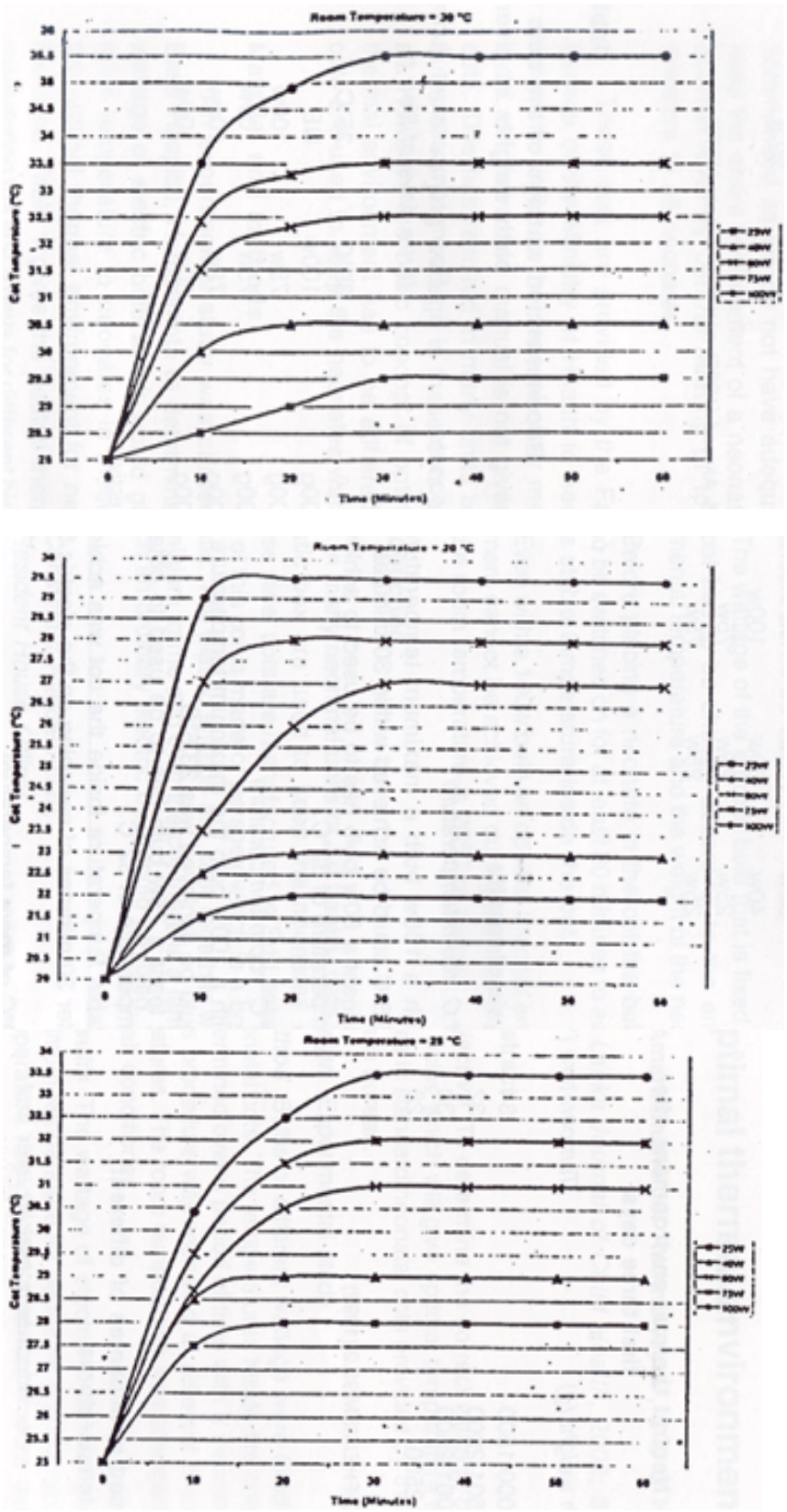

Figure 1 *Temperature rise in the cot at room temperatures of 30°C, 25°C, 20°C with bulbs of 25w, 40w, 60w, 75w, 100w.*

Analysis of results

At 30°C room temperature

- With a 100w bulb a maximum temperature of 35.5°C could be achieved within 30 minutes.
- At least a 60w bulb has to be used to achieve a temperature of 32°C.

At 25°C room temperature

- With a 100w bulb the maximum temperature that could be achieved was 33.5°C.
- At least a 75w bulb has to be used to obtain a temperature of 32°C.
- Stable temperature inside the cot was achieved after 30 minutes of switching on the electric bulb.

At 20°C of room temperature

- Even a 100w bulb, which is the maximum wattage of electric bulb available in the market, could not achieve a temperature higher than 29.5°C.

Discussion

This study shows the importance of monitoring the environmental temperature inside the neonatal units as the temperature inside cots, even when the electric bulb is switched on, changes significantly when environmental temperature changed.

It also shows that the ideal temperature of a neonatal unit should be 25-30°C if optimum temperature for the neonate is to be maintained.

It has become "fashionable" to aircondition new neonatal units in Sri Lanka. However, we have to re-think the wisdom of doing so. When a neonatal unit is airconditioned, it is difficult to maintain an optimum temperature for neonates though it may be comfortable for the caregivers.

It is also clear that wattage of the electric bulbs that are fixed to these neonatal cots have to be chosen according to the environmental temperature and the weight of the neonates.

Before placing a neonate in these cots the bulbs have to be switched on for at least 30 minutes to achieve a stable temperature inside the cots. Table 3 could be used to select the bulbs suitable for neonates of different weights at different room temperatures.

This study clearly shows that these cots are unable to achieve the optimum temperature (32.5°C) of even a 4000g neonate during the first three days of life if the room temperature is 20°C or below. Therefore we recommend re-designing the cot by fixing two or more electric bulbs if it is to be used in neonatal units which have a room temperature below 25°C.

References

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