Effectiveness of Conductive Warmers to Prevent and Treat Neonatal Hypothermia in Low-Resource Settings

Saige Sunier - Design that Matters

Abstract

Neonatal hypothermia contributes to millions of incidences of neonatal morbidity and mortality annually. In high resource settings it is prevented and treated using radiant warmers and incubators. These technologies are not always accessible to low-resource settings. Conductive warming is an alternative method for preventing and treating hypothermia that has gained major traction in recent years. This literature review explores the effectiveness of conductive warming and concludes that conductive warming is a non-inferior method to preventing and treating neonatal hypothermia.

Neonatal hypothermia is one of the main contributors to neonatal morbidity and mortality in low-resource settings (LRS). Newborns, especially preterm and low-birth weight (LBW) infants, have not yet developed the ability to control heat production and rapidly lose heat through evaporation, conduction, convection, and radiation.[12] In high-resource settings, the standard of care for treating and preventing neonatal hypothermia is using servo-controlled incubators and radiant warmers to maintain a temperature of 36.5ºC. These technologies are complex, expensive, and require a continuous supply of electricity, making them not sustainable in LRS.[10]

Kangaroo Mother Care (KMC), space heated rooms, and hats/blankets are common methods for maintaining thermoregulation in newborns. KMC is highly effective, however, it has limitations. Even a 30-minute break in warming can result in a temperature drop of 1.5ºC, resulting in the onset of mild hypothermia. Conductive warming devices have been encouraged by WHO, UNICEF, and other large aid organizations as a valid method for preventing and treating neonatal hypothermia when KMC is not available.[6,12]

Conductive warming as a prevention and treatment device has been studied for the past 30 years. A randomized controlled trial from Green-Abate in 1994 compared the extent of hypothermia prevention in 67 LBW newborns via space-heated room (SHR), heated water-filled mattress (HWM) and a temperature controlled incubator. The three-week study concluded that the incubator and HWM equally prevented hypothermia but the HWM resulted in slightly more cases of hyperthermia. SHR was significantly inferior to both the HWM and the incubator, resulting in the most cases of hypothermia and hyperthermia.[4]

Saraman, et al in 1989 conducted two separate trials comparing the temperature of newborns warmed on heated water-filled mattresses (HWM) to air heated incubators. The first, a three-week trial of 17 newborns warmed on a HWM compared to a control group of 17 newborns in an incubator, concluded the HWM was non-inferior in preventing hypothermia.[10] The second trial was a randomized controlled trial of 60 low birth weight newborns admitted to a NICU after being transported by family members to the hospital. All 60 newborns were hypothermic upon arrival. The neonates treated on the HWM reached stable temperatures faster than those treated in the incubator although there were higher rates of hyperthermia. Overall, the HWM was concluded to be non-inferior to the incubator (Figure 1).[9]

In more recent years, studies have been conducted to compare conductive thermal mattress, both thermal batteries and electric conductive warmers, to standard methods for preventing and treating hypothermia. In 2016, Bhat tested a conductive thermal mattress, Embrace, on its ability to prevent hypothermia as compared to the SoC of radiant warmers, swaddling, and KMC. The randomised controlled trial of 160 infants resulted in the conclusion that the CTM was non-inferior to the SoC, and often resulted in higher temperatures as compared to a radiant warmer over the course of 4 hours (Figure 2).[1]

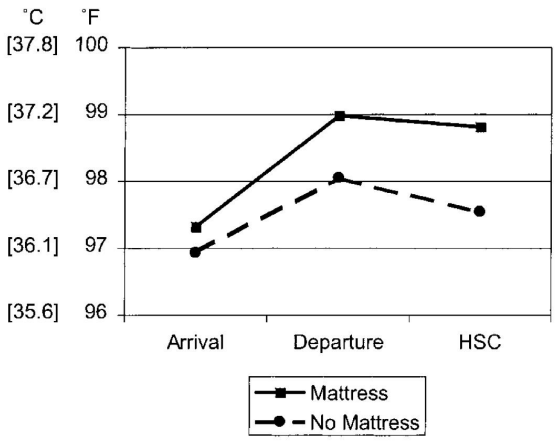
The only study that has differing results from the previously mentioned is Boo's study from 2005. This study looked at newborns delivered by lower segment caesarean sections in a OT that had an ambient temperature of 18ºC. The newborns were transported to a labour

room with an ambient temperature of 20ºC and placed on a HWM and covered with a blanket. Out of the 52.5% of newborns who were hypothermic upon arriving in the LR, 40.3% became normothermic after HWM treatment and 17.4% went from normothermic to mildly hypothermic.[2]

When using conductive mattresses there is a risk of hyperthermia if a proper protocol is not followed. A retrospective study was conducted in 2001 that compared the temperatures of newborns transported between hospitals prior to the introduction of a transport thermal mattress, TransWarmer, to the newborns' temperatures after introducing TransWamer. The study compared the temperatures of 191 newborns and reported that the average temperature upon arrival to the second hospital was 37.12ºC compared to 36.07ºC for the thermal mattress and swaddling, respectively.[7] TransWamer has been reported to cause incidences of hyperthermia and scalding if not activated in ambient temperatures below 28ºC.[3] Other conductive mattresses have a much lower incidence of hyperthermia and are considered effective for treating and preventing hypothermia.[1,5,11]

Conclusion

Overall, the studies conducted over the past 30 years generally conclude that conductive warming is a non-inferior method for preventing and treating hypothermia. In some cases, the conductive warming mattresses were more effective than incubators at helping newborns reach and maintain a stable temperature. Furthermore, a similar literature performed in 2017 looked at over 15 trials and concluded that conductive warming is a safe and effective alternative to treating and preventing hypothermia.[8] While there is a notable risk of hyperthermia when using certain products, conductive warming is still accepted as a method for treating and preventing hypothermia. It is a cost effective and accessible option for newborn warming that can help prevent neonatal hypothermia in low resource settings and reduce overall incidences of neonatal morbidity and mortality.



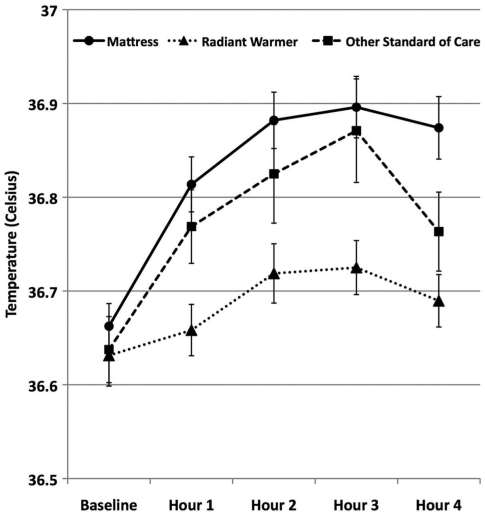


Figure 1 (left): Newborn body temperature: comparison of warming mattress and non mattress (Saraman, 1989).
Figure 2 (right): Conductive thermal mattress compared with radiant warmers as well as other standards of care (Bhat, 2015).

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