ISSN: 2230-9926

Available online at http://www.journalijdr.com

IJDR

International Journal of Development Research
Vol. 08, Issue, 09, pp. 22714-22718, September, 2018

ORIGINAL RESEARCH ARTICLE OPEN ACCESS

CAUTION ON THE THERMOREGULATION OF NEONATES IN USING OF THE HUMIDIFIED INCUBATOR

[*1]Wandra Camila Penaforte da Silva, [2]Karla Maria Carneiro Rolim, [3]Eloah de Paula Pessoa Gurgel, [4]Iliana Maria de Almeida Araújo, [5]Maria Veraci Oliveira Queiroz, [6]Lidiane do Nascimento Rodrigues, [7]Aliniana da Silva Santos and [8]Edna Maria Camelo Chaves

[1]Nurse, Master in Clinical Care in nursing and Health.
[2]Nurse, PhD in Nursing. University of Fortaleza, Health Sciences Center. Fortaleza, CE, Brazil
[3]Nurse, PhD in Nursing. Unichristus University Center, Health Sciences Center. Fortaleza, CE, Brazil
[4]Nurse, PhD in Nursing. Faculty of Education, Grande Fortaleza, Health Sciences Center. Fortaleza, CE, Brazil
[5]Nurse, PhD in Nursing, lecturer of the Post-Graduation Program in Clinical Care in nursing and Health (PPCCLIS), Ceará State University/PPCCLIS/UECE.
[6]Nurse, Master, PhD student, Post-Graduation Program in Clinical Care in nursing and Health (PPCCLIS), Ceará State University. Fortaleza (CE), Brazil
[7]Nurse, Master, PhD student, Post-Graduation Program in Clinical Care in nursing and Health (PPCCLIS), Ceará State University. Fortaleza (CE), Brazil
[8]Nurse, PhD in Pharmacology, lecturer of the Post-Graduation Program in Clinical Care in nursing and Health (PPCCLIS), Ceará State University/PPCCLIS/UECE

ARTICLE INFO

Article History:
Received 14th June, 2018
Received in revised form
22nd July, 2018
Accepted 19th August, 2018
Published online 29th September, 2018

Key Words:
Infant, newborn; Infant, Premature; Humidity; Body temperature regulation.

ABSTRACT

Identify the available evidence in the literature about the care with the use of humidified incubator for thermoregulation of premature newborns. **Methods:** integrative review that includes original articles published in scientific journals and without delimitation period. Among the 23 works found, they were analyzed seven productions indexed in basesSciense Direct, Ebsco Hostand Biomedical Literature Citations and Abstracts. **Results:** The temperature can be controlled in four ways: evaporation, conduction, convection and radiation. The high moisture maintenance is essential to reduce the loss of body water and evaporative cooling of the skin, observed in less mature infants with a thinner skin. **Conclusion:** moisture has an important role in thermoregulation of premature, influencing the reduction of transepidermal losses that are directly related to gestational age, especially in the first weeks of life.

Citation: Wandra Camila Penaforte da Silva, Karla Maria Carneiro Rolim, Eloah de Paula Pessoa Gurgel, *et al.* 2018. "Caution on the thermoregulation of neonates in using of the humidified incubator", *International Journal of Development Research*, 8, (09), 22714-22718.

INTRODUCTION

During pregnancy, maternal mechanisms maintain the intrauterine temperature, but after birth, newborns need to adapt to the environment relatively cool environment by metabolic heat production as they are unable to generate adequate response by chills (Cloherty *et al*. 2015).

Corresponding author: **Wandra Camila Penaforte da Silva**
Nurse, Master in Clinical Care in nursing and Health.

Premature newborn baby has a good chance of developing respiratory disorders, metabolic, ineffective thermoregulation, among others, due to the immaturity of their systems. Thermoregulation is understood as the body's ability to promote the balance between heat production and loss, thereby maintaining body temperature within the normal range (Tamez, 2013). Thermoregulation is a physiological function closely related to the transition and survival of newborns. These have the ability to control body temperature, but in extreme temperature conditions (very low or very high), this condition is weakened by physical inability to maintain

homeostasis. Temperature changes are manifested through two mechanisms: hypothermia and hyperthermia. Inadequate care and anatomical and physiological conditions of preterm infants often trigger episodes of hypothermia. Thus, hypothermia may be defined as axillary temperature below 35 ° C (Cloherty *et al*. 2015)-(Tamez, 2013) - (Knobel *et al*. 2013). Monitoring and maintaining body temperature are nursing care for maintaining stable thermal environment neutral. The nurse, in clinical practice, should establish priority targets for assistance to the newborn. It is important that nursing has extensive knowledge about the mechanisms of thermal control, heat loss, and risks that may cause thermal instability for these patients (Tamez, 2013). The Nursing team, therefore, need to adopt appropriate practices, so that the premature newborn will not lose heat, as heat it, performing the first immediate care after the childbirth, keep it in a heated incubator and humidified properly, as also spaced walls and windows and air currents. The growing number of Neonatal Intensive Care Units, as well as the availability of technology in high-risk care units, have significantly contributed to decreased mortality and morbidity of premature and other newborns. There is the technological evolution of the incubators used in these units.

Controlled thermal environments are commonly provided through closed incubators operating according to the methods of air or servo control skin. The stability of the thermal environment is very important for the care of the newborn infants with very low weight. The thermal environment is relatively stable in a servo-controlled incubator by the temperature of the skin or frequent manual adjustments incubator air temperature (Deguines *et al*. 2013). In the incubator, premature newborn is heated by convection. As the temperature of the incubator walls can not be controlled, it suffers temperature changes according to the changes in this room environment. The radiant heat loss from the child to the wall of the incubator is also variable and depends on the external environment. A double dome minimizes the temperature changes inside the incubator, resulting from variations in ambient temperature, because it compensates the high radiant heat loss (Brazil, 2011). The humidified incubator contributes to maintaining the lives of newborns, to maintain the relative humidity above 75% by adjusting the temperature of the environment of the incubator, weight and packaging (temperature newborn gowns should be approximately 0.5 ° C lower compared non dresses). The loss of fluids through the skin can be expressed more accurately by measuring the body surface, or may be related to weight. Among the main factors related to transepidermal water loss are:gestational age, time of life, environmental factors (temperature and humidity) and weight (Mendes *et al*. 2008). The humidified incubator provides the high humidity of the air function, with servo-control of temperature. This has a reservoir, which is placed in distilled water that will promote adequate humidification. At high levels of humidity inside the incubator dome (typically greater than 60%), condensation may form on the inner walls of the dome (Mendes *et al*. 2008). Nursing professionals must have knowledge and skills to observe the physiological changes of the baby, the causes of temperature variations and maintaining adequate environments to maintain body temperature and the minimum balance metabolic rate. This time, the study brings contributions to the practice of neonatal nursing, because it presents evidence that can guide specific care thermoregulation of premature newborns in health risk conditions.

Therefore, the study aimed to identify the available evidence in the literature on the care with use of humidified incubator for thermoregulation of premature newborns.

MATERIALS AND METHODS

Integrative review study method that meets the relevant scientific literature about a given theme, allowing a built-wide analysis of the literature, thus offering quick access and synthesized to scientific results most important to the area, from a guiding question (Souza *et al*.2010) - (2009 Pompeo *et al*.). The steps for the preparation of this review were: problem identification; search for articles in the literature; categorization of the studies; evaluation of the sample; Interpretation of results; analysis and synthesis of articles (Ursi *et al*., 2006). As a guide of the research, we used the following guiding question: what are the available evidence in the literature on control of thermoregulation of premature newborn?

The search for articles was carried out between October 2015 and January 2016, in the following virtual paths: the Virtual Health Library, the bases*Sciense Direct and Ebsco Host,* Biomedical Literature Citations and Abstracts (PubMed), contained in the Bank of Higher Education Personnel Improvement Coordination Databases (CAPES). The searches were conductedthe following descriptors in Health Sciences, in Portuguese Descriptors, and Medical Subject Heading (MeSH) for terms in English. The selected descriptors were: Newborn (Infant, Newborn); Premature (Infant, Premature); Humidity (Humidity) and temperature regulating body (Body Temperature Regulation). It was used in the crosses the Boolean operators AND and OR. In the first search were found on the Virtual Health Library 82 articles, *Sciense Direct and Ebsco Host with* 200 articles, and PUBMED 87 articles.

This was followed by reading the summary noting the inclusion criteria: original articles published in scientific, journals available in full, with free and restricted access to answer the guiding question; studies available in English, Portuguese or Spanish, not fixed period of studies to achieve the greatest possible number of publications. Exclusion criteria: review articles and editorials. Were read 16 articles, and were selected seven articles that answered the main question. The selected studies were organized according to an instrument (Ursi *et al*. 2006) that addresses the following items: item identification, home institution of the study, type of publication, methodological characteristics and evaluation of methodological rigor. The results are tabulated and based on the literature.

RESULTS

Of the total studies, two to Sciense Direct, four in PubMed; one in the Virtual Health Library. The year with major publications in the subject were 2011, with two articles. The countries that have been published over were England and United States, with two items each. The magazine with the largest number of publications was the Journal of Obstetric, Neonatal Nursing &Ginecologic with two publications; in relation to the type of study, five were quantitative, characterized as randomized clinical trials, and two qualitative.

Table 1. Description of the selected articles on the care and factors that contribute to changes in thermoregulation

Authors and magazine	titles	Participants	results
V Turnbull, J. Petty Nursing Children and Young People	Evidence-based thermal care of low birth weight neonates	Newborn weighing 1 kg at 27 weeks and 6 days of gestation.	In the delivery room, the newborn, who underwent resuscitation and intubation, received the following precautions to maintain thermoregulation: knitted cap, transferred to the neonatal unit in pre-heated transport incubator at 35 ° C and plastic bag wrapping the body. Auxiliary temperature was 36.7ºC.
Rolim KMC, Araújo AFPC, NMM Campos Lopes SMB, Gurgel EPP, ACS Campos. Journal of Northeastern Nursing Network	Watch as thermoregulation of premature newborn: Nurse view	Unit neonatal nurses	Heat the newbornputting into the incubator or radiant heat cradles, maintaining the dried covered avoid open the incubator to perform procedures to maintain the humidifier respirator with bound water at 37 ° C, pre-heating milk, controlling the incubator temperature or crib radiant heat, check the temperature of the new born 3/3 hours and when necessary.
Helder OK, Mudler PGH, Goudoever does JBV. Journal Obstetric Gynecology Neonatal Nursand	Computer-Generated Versus Nurse-Determined Strategy for Incubator Humidity and Time to Regain Birthweith	Premature from 24 to 30 weeks and birthweight less than 1500 grams.	It is shown that the proper humidity in the incubator could contribute to reduction of transepidermal water loss. Yet another problem is to determine the effect of moisture in premature new born weighing less than 500 grams.
Knobel R, D-Davis Holditch. Advanceneonatal Care	Thermoregulation and heat loss prevention after birth and neonatal intensive care unit During stabilization of extremely low birthweight infants	Extreme newborn with low weight	Results showed that the procedures performed in babys with low birth weight, such as umbilical catheter insertion, intubation, obtaining radiographs, manipulation of intravenous lines, repositioning, aspiration and vital signs during the first 12 hours of life contributes to the imbalance thermoregulation.

Table 2. Description of the selected articles on the impact of humidification of incubators thermoregulation of the newborn

Authors and magazine	Title	Participants	results
Deguines C, Tenth P Pelletier A Dégrugilliers L, L Ghyselen, P. Tourneux Acta Pediatric	Variations in temperature and humidity incubator management - a survey of current practice	Professional neonatal units.	Obtained 86% return of the questionnaires. The air temperature servo-control was mainly used for newborns with gestational age of 28 weeks and older than 7 days old according to clinical protocol. Variations in care related to temperature and humidity parameters, and 65% use fixed values.
Enilson JL, Costa RCS, JBA Freire, Silva CMP Cursino CR BAM Oliveira, Pereira RFL Acta IMEKO	Humidity Control System in Newborn Incubator	Newborn that were in incubators with water and without water in the reservoir.	The relative humidity inside the incubator with humidified water in the reservoir is maintained at the proper level. Incubator with no water reservoir has committed humidity inside the dome.
Harpin VA, Rutter N Archive Disease Children	Humidification of incubators	Newborns under 30 weeks. A group with high humidity	The humidification reduces the skin water loss and improves the maintenance of the body temperature, but doesn't retards the maturation of postnatal skin. Newborns heated without moisture, have become hypothermic, despite the high temperature of the air incubator. These advantages should be evaluated since overheating favors Pseudomonas growth in newborn environment.

DISCUSSION

The thermoregulation of premature maturation depends on the integrity of the skin, which works as an essential barrier between the human body and the environment. A fetus develops a dead skin cells from the surface skin filled with keratin at 18 weeks of gestational age. Birth prematurely, yet show the permeable skin, causing transepidermal water loss during the firsts days of life. The control of temperature and humidity are important in the early days of life. The premature newborn has large body surface area to weight ratio and is suitable for high transepidermal water loss. Study with babys with very low weight, found to be approximately 150 ml / kg / day for the first 24 days of life, decreasing to 12 ml / kg / day in those aged 31 weeks or later. The transepidermal water loss in premature infants of 26 gestational weeks is up to six times bigger than in term infants (Helder, *et al*., 2008). The scientific literature shows that the temperature can be controlled in four ways: evaporation, conduction, convection and radiation. It is important to recognize that the temperature of the newborn's body can fall by 0.2 to 1.0ºC every minute, depending on the gestation and environmental factors, and can not be controlled in the pregnancy, it is vital that hypothermia is prevented, manipulating the neonatal environment. The temperature loss in premature occurs for several reasons: Ineffective positioning capability of the child, larger body of water content, reduction in subcutaneous and brown fat, immature skin, reduced capacity to peripheral vasoconstriction and metabolic mechanisms undeveloped (Turnbull *et al*. 2006). To prevent hypothermia its important to keep all the care together to reduce the constant opening of the incubator portholes, the use of water heated to 37º in hygiene, the use of cap, the supply of heated and humidified gas. Another important point is that the premature baby has about five times more body surface area than weight ratio. Thus, the losses are higher because the water reserves are proportionally closer to the surface and more easily accessible and mobilized. Furthermore, the skin from premature newborn is characterized by having increased vascularization, favoring higher permeability to water. This also enhances the probability of loss by evaporation. This superior permeability can also be explained by a developing stratum corneum skin layers thinner and lack of keratin. In premature birth, the increase is correlated with the increasing losses (Enilson *et al*. 2009). It is evident, therefore, that the premature newborn is most suitable for the thermal imbalance in relation to the newborn, due to body immaturity.

The incubator is a device used for maintaining the life of the newborn, in which they are neutral thermal environment whose conditions are compared to those found in the uterus. The newborn should have environment whose temperature and relative humidity are controlled, being able to develop rapidly, with less risk of disease (Enilson *et al*. 2009). It is considered air humidity, the gas mixture of dry air and water vapor. The absolute humidity (in grams per kilogram) is defined as the amount of water vapor in the dry air (Telliez *et al*. 2001). The heat stress in the newborn has been associated to an increased mortality and morbidity. The premature baby is particularly vulnerable because of the increased heat loss and immature or absent thermoregulatory mechanisms. Even with modern temperature control methods, the increased demand caused by thermal stress can result in insufficient power for good growth (Deguines *et al*. 2012). It is known that there is room temperature, called the thermal neutrality, in which there is a minimal expenditure of energy to maintain body temperature, and for premature, is locatedbetween 32º C and 35º C, with 50% humidity, which allows to maintain the body temperature of premature between 36 C and 36,5º C. The nurse must assess the body temperature of premature each turn and make the necessary adjustments to continue the stabilization of body temperature. All efforts should be made to maintain the environment with thermal neutrality (Rolim *et al*. 2010). Avoid opening the incubator for procedures that can be performed by professionals with more skill and dexterity. The minimal handling protocol is a tool to be implemented in neonatal units.

It has been shown in a study that the moisture and the airflow and temperature radiating around the incubator surface could control the heat loss or gain, keeping stable the newborn to a metabolic consumption of minimum oxygen (Knobel *et al*. 2007). To establish a safe level of humidity is required careful clinical analysis. At least 50% of ambient humidity is needed for premature newborns and 85% in extreme prematurity, which are those with 26 or fewer weeks of gestation. This moisture is maintained around 7 to 14 days (Turnbull *et al*. 2013). They are also considered to moisture establishment the days of life, skin maturity and underlying medical conditions. As increasing postnatal age and gestational age older, it should reduce the relative humidity (Telliez *et al*.2001). The proposal to use the moisture to provide thermoregulation in premature babies is not new; in fact, the practice has been used for at least 75 years. Thus, it is important to have basic knowledge of neonatal physiology, and as the use of the moisture may be important in the early treatment of babies at risk. Heat loss by evaporation is the main source of heat loss and instability of the temperature in the first weeks of life (Fidler, 2011). Losses by immature skin barrier of premature newborns are related to three factors: body surface area, skin permeability and environmental conditions. Even more alarming is the fact that the evaporation losses decrease with increasing postnatal age for preterm child; at 28 days of postnatal age (regardless of the gestational age of the newborn), heat losses by evaporation remain at least twice that of the newborns in the same postnatal age(Helder *et al* 2008) - (Fidler, 2011). The rationale for the use of moisture is based on the knowledge of the temperature control and reducing heat losses by evaporation. In a cool, dry environment, the rate of heat exchange by evaporation from the skin surface and the surrounding air in the incubator can be so high that the evaporation loss may exceed the total production of infant metabolic heat. It has been found in several studies that water loss by evaporation baseline can be consistently reduced by increasing the concomitant ambient temperature with the addition of moisture (Fidler, 2011) - (Deguines *et al*. 2012) - (Knobel *et al* 2007) - (Harpin *et al* 1995).

Literature data suggest that the high moisture maintenance is essential to reduce the large loss of body water and evaporative cooling of the skin, observed in mature infants with a thinner skin. One way to reduce transepidermal water loss and improve the energy balance of premature babies is to increase the humidity. The high moisture saturated environment within the incubator suppresses evaporation from the skin (Deguines *et al*. 2012). In the 1980s, as was thought about the humidification versus transdermal loss correlation, humidification is a highly effective way to reduce evaporative water loss specifically for the care of very young children, immature. Therefore, the loss of water from the skin constantly decreases and most of this reduction occurs in the first week (Harpin *et al*. 1995). Water losses to premature newborns with 25 weeks of gestation, treated in an environment with relative humidity of 20% is greater than 200 ml / kg / day. The increase of relative humidity inside the incubator neonatal reduces water loss to the skin of premature infants under 30 weeks of gestation and contributes to maintaining the temperaturebody (Cloherty *et al*. 2015).

In the early days of life, the daily evaporation loss can reach up to 20% of body mass. This loss can be reduced by increasing the humidity inside the incubator. Confirming the above study shows that the insensible water loss through the skin is the main source of normal weight loss among newborns during the first week of life. The degree of loss transepidermal evaporation is directly related to the gestational age of the baby. The more immature the infant, the greater the potential for loss as much as 10 to 15 times higher in the first few weeks of extremely premature infants (Fidler *et al*. 2011). The concentration in the walls is directly related to the internal humidity in the incubator and room temperature. So the humidified incubator maintains a relative humidity level that influences the development of skin barriers, providing growth and faster ripening. Due to evaporation of water from the skin surface to generate consequent heat loss, reduction of transepidermal losses also improves the thermal balance of the newborn (Mendes *et al*., 2008). The nurse must be an active agent in control of thermoregulation of newborns, especially regarding the use of technology for its control. It is emphasized at this point, the use of humidified incubator, as it can not alone determine the optimal humidity, and its needed a professional knowledge to better match. As well as your daily maintenance in the exchange and / or replacement of the fluid that keeps moisture because their absence may favor infections or will not get the ideal humidity level.

Conclusion

Studies highlighted that moisture has an important role in thermoregulation of premature newborn, influencing the reduction of transepidermal water loss that are directly related to gestational age, especially in the first weeks of life. Moisture can be used immediately after birth in preterm infants, facilitating even in the maturation of skin barriers. The heated and humidified incubators are part of the therapeutic arsenal used in neonatal units to assist in the control of premature thermoregulation, which is vulnerable thermostatic function in the first weeks of life.

Thanks

I sincerethank the authors of the study for his contributions in each step of the construction.

REFERENCES

Brazil. Ministério da Saúde 2011. Atenção à Saúde do recém-nascido: cuidados com o recém-nascido pré-termo. Brasília, DF: Ministério da Saúde.

Cloherty JP, StarkAR. 2015. Manual de neonatologia. Rio de Janeiro: Medsi; [cited 2017 Oct 5].

Deguines C, Décima P, Pelletier A, Dégrugilliers L, Ghyselen L, Tourneux P 2012. Variations in incubator temperature and humidity management: a survey of current practice. ActaPaediatr. 101(3):230-5.

Deguines C, Dégrugilliers L, Ghyselen L, Chardon K, Bach V, Tourneux P 2013. Impact of nursing care on temperature environment in preterm newborns nursed in closed convective incubators. Acta Pediatr. 102(3):96-101.

Enilson JL, Costa RCS, Freire JBA, Silva CMP, Cursino CR, Oliveira BAM, Pereira RFL 2009. Humidity Control System In Newborn Incubator. Portugal: ActaImeko. 1760-4.

Fidler HL 2011. Incubator Humidity: more than just something to sweat about! *Adv Neonatal Care*. 11(3):197-9.

Harpin VA, Rutter N 1985. Humidification of incubators. Arch Dis Child. 60:219-24.

Helder OK, Mulder PG, Van Goudoever JB. 2008. Computer-generated versus nurse-determined strategy for incubator humidity and time to regain birthweight. *J ObstetGynecol Neonatal Nurs.* 37:255-61.

Knobel R, Holditch-Davis D. 2007. Thermoregulation and heat loss prevention after birth and during neonatal intensive-care unit stabilization of extremely low-birthweight infants. *J ObstetGynecol Neonatal Nurs.* 36(3):280-7.

Knobel RB, Levy J, Katz L, Guenther, Holditch-Davis D 2013. A pilot study to examine maturation of body temperature control in preterm infants. *J ObstetGynecol Neonatal Nurs*. 42(5):562–574.

Mendes KDS, Silveira RCCP, Galvão CM 2008. Revisão integrativa: método de pesquisa para a incorporação de evidências na saúde e na enfermagem. TextoContextoEnferm. 17(4):758-64.

Pompeo DA, Rossi LA, Galvão CM 2009. Integrative literature review: the initial step in the validation process of nursing diagnoses. Acta Paul Enferm. 22(4):434-8.

Rolim KMC, Araújo AFPC, Campos NMM, Lopes SMB, Gurgel EPP, Campos ACS 2010. Cuidado quanto à termorregulação do recém-nascido prematuro: o olhar da enfermeira. Rev Rene. 11(2):44-52.

Souza MT, Silva MD, Carvalho R 2010. Revisão integrativa: o que é e como fazer. Einstein. 8(1):102-6.

Tamez RN 2013. Enfermagem na UTI Neonatal: assistência ao recém-nascido de alto risco. Rio de Janeiro: Guanabara Koogan.

Telliez F, Bach V, Delanaud S, Leke A, Abdiche M, Chardon K 2001. Influence of incubator humidity on sleep and behaviour of neonates kept at stable body temperature. ActaPaediatr. 90(9):998-1003.

Turnbull V, Petty J 2013. Evidence-based thermal care of low birthweight neonates. *NursChild Young People*. 25(3):26-9.

Ursi ES, Galvão CM 2006. Prevenção de lesão de pele no perioperatório: revisão integrativa da literatura. Rev Latino-Am Enfermagem. 14(1):124-31.

****