ORIGINAL ARTICLE

The effectiveness of using semipermeable membrane in preterm infants to reduce transepidermal losses*

EFICÁCIA DO USO DE MEMBRANA SEMIPERMEÁVEL EM NEONATOS PRÉ-TERMO NA REDUÇÃO DE PERDAS TRANSEPIDÉRMICAS

EFICACIA DEL USO DE MEMBRANA SEMIPERMEABLE EN NEONATOS PREMATUROS PARA REDUCCIÓN DE PÉRDIDAS TRANSEPIDÉRMICAS

Eloah de Paula Pessoa Gurgel[1], Joselany Áfio Caetano[2], Marcos Venícios de Oliveira Lopes[3], Karla Maria Carneiro Rolim[4], Paulo César de Almeida[5], Fernanda Jorge Magalhães[6], João Osmiro Barreto[7]

ABSTRACT

An investigation was made on the effectiveness of using semipermeable membrane on the skin of preterm infants on the evolution of weight loss and blood glucose values, water share, urine specific gravity and sodium. This is an experimental study, of the randomized clinical trial type, carried out from March to August 2008 in the Neonatal Intensive Care Unit of the Teaching Maternity Assis Chateaubriand (TMAC) in the city of Fortaleza-Ceará. The sample consisted of 42 preterm infants. The data were presented in tables and charts. In the application of the semipermeable membrane, the preterm infants of the intervention group (IG) had a decrease in the sodium levels and the daily flow demands, they also presented fewer hyperglycemia episodes and the urinary density was kept within normal patterns. The semipermeable membrane is, in fact, an effective therapeutic resource to minimize transepidermal water losses.

DESCRIPTORS

Infant, newborn
Infant, premature
Skin
Therapeutics
Neonatal nursing

RESUMO

Neste estudo, investigou-se a eficácia do uso da membrana semipermeável na pele de recém-nascido pré-termo sobre a evolução da perda ponderal e valores da glicemia, cota hídrica, densidade urinária e sódio. Estudo experimental, tipo ensaio clínico randomizado, realizado no período de março a agosto de 2008, na Unidade de Terapia Intensiva Neonatal, de uma maternidade pública, na cidade de Fortaleza-Ceará. A amostra foi constituída de 42 recém-nascidos pré-termo. Os dados foram apresentados em tabelas e quadros. Na aplicação da membrana semipermeável, os recém-nascidos pré-termos do Grupo de Intervenção tiveram uma diminuição de níveis de sódio e de exigências fluidas diárias, como também apresentaram menores episódios de hiperglicemia e a densidade urinária foi mantida dentro dos padrões de normalidade. A membrana semipermeável é, de fato, um recurso terapêutico eficaz para minimizar as perdas de água transepidérmicas.

DESCRITORES

Recém-nascido
Prematuro
Pele
Terapêutica
Enfermagem neonatal

RESUMEN

Investigar la eficacia del uso de membrana semipermeable en piel de recién nacido prematuro acerca de evolución de pérdida ponderal y valores de glucemia, cota hídrica, densidad urinaria y sodio. Estudio experimental, tipo ensayo clínico randomizado, realizado de marzo a agosto de 2008 en Unidad de Terapia Intensiva Neonatal de una maternidad pública en Fortaleza-Ceará. La muestra se constituyó de 42 recién nacidos prematuros. Los datos se presentaron en tablas y cuadros. En aplicación de membrana semipermeable, los recién nacidos prematuros del Grupo de Intervención tuvieron una disminución de niveles de sodio y de exigencias fluidas diarias, también presentaron episodios menores de hiperglucemia y la densidad urinaria se mantuvo dentro de los patrones normales. La membrana semipermeable es, de hecho, un recurso terapéutico eficaz para minimizar las pérdidas de agua transepidérmicas.

DESCRIPTORES

Recién nacido
Prematuro
Piel
Terapéutica
Enfermería neonatal

* Extracted from the thesis "O uso da membrana semipermeável como proteção da pele do recém-nascido prematuro", Federal University of Ceará, 2008.
[1] MA in nursing, Federal University of Ceará. RN, Neonatal unit at the Assis Chateaubriand Maternity School. Professor, University of Fortaleza, Undergraduate Nursing Program. Researcher at the Group of Health and Quality of Life of the Binomial Mother and Child - UNIFOR/CNPq. Fortaleza, CE, Brazil. eloahgurgel@yahoo.com.br [2] PhD in nursing. Professor, Federal University of Ceará. Fortaleza, CE, Brazil. joselany@ufc.br [3] PhD in nursing. Professor, Nursing Department, Federal University of Ceará. Fortaleza, CE, Brazil. marcos@ufc.br [4] PhD in Nursing, Federal University of Ceará. Nurse, Neonatal unit at the Assis Chateaubriand Maternity School. Professor, University of Fortaleza, Undergraduate Nursing Program. Researcher in the Health and Quality of Life of the Binomial Mother and Child Group - UNIFOR/CNPq. Fortaleza, CE, Brazil. karlarolim@unifor.br [5] Doutor em Saúde Pública pela Universidade de São Paulo. Professor Adjunto da Universidade Estadual do Ceará. Fortaleza, CE, Brasil.pc49almeida@gmail.com [6] RN. Specialist in Neonatology. Substitute Professor, Federal University of Ceará. Researcher at the Health and Quality of Life of the Binomial Mother and Child Group - UNIFOR/CNPq and Study Group on Nursing Consultation at the Federal University of Ceará. Fortaleza, CE, Brasil. fernandajmagalhaes@yahoo.com.br [7] MA in Clinical Care, State University of Ceará. Neonatologist Physician, Neonatal unit at the Assis Chateaubriand Maternity School, Federal University of Ceará, CE, Brazil. josmiro@uol.com.br

Português / Inglês
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Received: 03/30/2010
Approved: 11/13/2010

INTRODUCTION

The incidence of skin problems in newborns weighing less than 1,500g is high because the skin of preterm newborns (PTNB) has few layers of stratum corneum, is slender, reddish with visible and superficial veins. Additionally, dermo-epidermal cell cohesion is weak, possessing a small volume of collagen and elastin fibers. Skin appendages are immature and hypodermis is stunted[1].

Among the disturbing conditions faced during care delivered to PTNB, prevention and treatment of skin lesions require particular care since the skin is thin and extremely susceptible to lesions. Hence, during intensive care provided to newborns, keeping the integrity of the infant's skin is a challenge for the nursing staff, which has to safely fix the endotracheal tube, sensors, probes, venous infusion catheter and other material on the immature skin without causing severe lesions since the presence of lesions is a complicating factor in establishing newborns' health.

One of the main complications of immature skin is transpidermal water loss, which is intensified with the occurrence of skin lesions that break the skin barrier against evaporation. Such lesions can result from the removal of adhesives, monitors or exposure of skin to disinfectant solutions, as well as skin birth defects such as those found in omphalocele, gastroschisis, and neural tube defects[2].

Among the covers used to protect skin, the semipermeable membrane deserves special attention as a protection for newborns' skin. It is undoubtedly a technological advancement both for nursing care and neonatal care improvement. One of its purposes, in addition to protecting a PTNB's skin, is to reduce transpidermal water loss. Such loss can cause hypothermia, dehydration, and hyperosmolaty[3].

> ...Brazilian research addressing care provided to infants' skin and the use of the semipermeable membrane is still incipient.

The semipermeable membrane has been in use since the 1980s as a protection for newborns' skin. The first experience was in 1989 to reduce water loss, through the application of a transparent adhesive dressing on the skin of PTNB weighting from 770g to 1,450g[4]. Various studies reveal that transparent adhesive dressings can be used to impede excessive water loss from PTNBs' skin[1-2,5]. However, Brazilian research addressing care provided to infants' skin and the use of the semipermeable membrane is still incipient. Therefore, studies addressing this topic are needed to fill in this gap since the skin is the body's largest organ and has important functions for the survival of newborns. Given its relevance, we ask: does the semipermeable membrane contribute to the reduction of complications related to the immaturity and fragility of PTNBs' skin?

To address such a question, this study investigates the efficacy of semipermeable membranes used on PTNBs' skin in relation to weight loss and blood glucose values, water quota, urine density and sodium.

METHOD

This experimental, randomized clinical trial was carried out in a public hospital that provides tertiary maternity service, referral for obstetrical and neonatal care in Fortaleza, CE, Brazil. The studied population was composed of PTNBs hospitalized in the Neonatal Intensive Care Unit (NICU) from March to August 2008.

The sample was composed of PTNBs who met the following inclusion criteria: weighing ≤ 1,500g and of a gestational age ≤ 32 weeks; remaining in the unit for seven days; without severe malformations that affect skin integrity nor led to death during the study period such as gastrochisis, menigomyelocele, omphalocele, obstetric traumas. The exclusion criteria included: newborns in a debilitated health condition that would hinder the study's conclusion, having a congenital malformation such as gastrochisis, menigomyelocele, omphalocele or obstetric traumas.

PTNBs were randomly drawn at the time of their admission into NICU. For that, a box with 42 small pieces of paper was used, the word YES was written on 21 papers and the word NO was written on the remaining 21 papers. The Intervention Group (IG) was composed of those infants who at the time of admission were drawn with the word YES, as long as they met the inclusion criteria. The Control Group (CG) was composed of newborns who were drawn with the word NO. The infants' medical files were identified with a stamp containing the word SKIN and were differentiated from the others. A thin membrane of semipermeable polyurethane 6x7cm was applied on the intact skin of PTNBs in the IG. It was fixed on the infants' chest, abdomen, back and extremities and remained up to the end of the first week of life.

A form was used to identify the study's participants containing data and hour of birth, anthropometric measures such as weight, height, head and chest circumference, gestational age (last menstruation, early ultrasound, and new Ballard score), medical diagnosis. The following dependent variables were considered: weight loss, blood glucose values, water quota, urine density and sodium levels. An observation form was used to record information concerning the date and time the semipermeable membrane was applied, endovenous therapy, nutritional support, ventilation support (oxi-hood, nasal CPAP and mechanical ventilation (MV), non-humidified incubator, radiant-heat cradle, phototherapy (Billispot and Biliberco) and changes in temperature. The NICU's standard air temperature kept inside the incubator was between 34ºC and 36ºC.

Even though the incubator's temperature, the newborn's temperature and level of humidity within the incubator are important variables to be considered in transpidermal water loss, these parameters were not evaluated in this study because the facility under study did not have humidified incubators and the unit's practice is to keep a standard temperature.

The PTNBs were monitored through laboratory exams, daily weighing, water balance, urine density, blood glucose control, sodium dose and daily water quota. A field diary was used to note ambience and intercurrences within the NICU.

Data were organized in tables. The statistical measures of central tendency and dispersion were calculated in addition to epidemiological measures of sensitivity and specificity. A confidence interval of 95% was calculated for these parameters. Regression analysis was performed for the outcome variables: weight, urine density, sodium, water quota and blood glucose. The level of significance was fixed at 5%. Data were processed in the SPSS, version 11.0.

The study was approved by the Research Ethics Committee at the Assis Chateaubriand Maternity School, Federal University of Ceará according to the recommendation of the National Council of Health, Ministry of Health Resolution 196 from October 10, 1996 regarding research with human subjects (official letter nº 137/06 and protocol nº 59/06)[6].

RESULTS

To facilitate the presentation and analysis, data were organized as: characterization of the PTNBs, procedures implemented in the NICU during hospitalization and evaluation of the newborns' transpidermal and hydroelectrolytic losses.

Characterization of the newborns

Analyzed data refer to gender, type of birth, birth weight, classification of weight and gestational age, anthropometric data (height, head and chest circumference), origin, and hospitalization medical diagnosis. The distribution of the variable 'gender' among the newborns was 25 male and 17 female infants.

In relation to weight, the PTNBs weighed between 620g and 1,495g; all were classified as very low birth weight infants. The average gestational age in the IG was 206.05 days, that is, 29 weeks and four days, standard deviation was 16.354. The CG had an average of 201.33 days, that is, 28 weeks and seven days, standard deviation was 14.207 days (Table 1). In relation to height, the average for the IG was 36.6cm and for the CG was 35.7cm. The average head perimeter was 25.4cm for the IG and 25.7 cm for the CG. The average chest circumference for the IG and CG was 22.3cm and 21.3cm respectively.

All the newborns came from the Obstetric Center and the main medical diagnoses at admission were: respiratory distress syndrome, prematurity, and neonatal asphyxia. The duration of hospitalization in the NICU varied from six to 136 days. The CG stayed an average of 19.3 days, standard deviation 12.7, the IG stayed for an average of 16.69 days, standard deviation was 20.7. Hence, the IG spent less time hospitalized compared to the CG.

Procedures implemented in the NICU during the hospitalization

Data from the participants' medical files were used to identify the procedures implemented in the NICU concerning care provided to the neonates such as: non-humidified incubators, phototherapy, ventilation and nutritional support, and the use of endovenous therapy.

All 42 PTNBs from both the IG and CG remained in non-humidified incubators given their thermal instability with a temperature between 34°C to 36°C. In relation to the need of phototherapy treatment, 15 (71.4%) PTNBs from the IG and 14 (66.7%) from the CG were underwent the use of Billispot. In relation to the use of ventilation support, 20 (95.2%) PTNBs from the IG and 21 (100%) from the CG underwent MV.

A total of 15 (71.4%) PTNBs from the IG and 20 (95.2%) from the CG used parenteral nutrition. Both groups were early exposed to it around the third day of life; 17 (81%) newborns from the IG and 13 (61.9%) from the CG initiated this parenteral nutrition due to respiratory instability. A total of 17 (81%) PTNBs from the IG and 21 (100%) from the CG had endovenous therapy via umbilical catheter, which were kept until hemodynamic conditions were stable.

Assessment of the PTNBs' transpidermal and hydroelectrolytic losses

The following variables were investigated to monitor the PTNBs during the seven days: weight, urine output, blood glucose, water quota, urine density and sodium. Average and standard deviation was computed for each variable of the CG and IG.

According to table 1, birth weight varied in each group. The IG varied between 715g and 1,485g with an average of 1,080g, standard deviation of 243.3g. A variation between 620g and 1,495g was observed in the CG with an average of 1,027.9g, standard deviation of 264.0g. The CG presented an average below that of the IG. Table 1 also shows an average weight loss of 107.4gr for the IG at the end of the seventh day and 99.5gr for the CG. It is important to observe the averages of the IG and CG. Even though the IG lost more weight, the group's average weight was above that of the CG. Hence, the CG presented a lower birth weight. Because it is a randomized trial, there was no previous knowledge of which newborns would compose the IG or the CG.

Table 1 - Descriptive statistics of the variables: weight, urine output, blood glucose, water quota, urine density and sodium of PTNBs in the IG and CG - Fortaleza, CE, Brazil - 2008

Variables	1st day		2nd day		3rd day		4th day		5th day		6th day		7th day	
	Average	SD	Average	SD	Average	SD	Average	SD	Average	SD	Average	SD	Average	SD
IG weight	1081.4	237.96	1059.1	229.29	1034.8	226.37	985.95	232.73	974.52	229.01	974.05	228.641	974.05	230.68
CG weight	1021.2	264.3	1009.8	258.401	976.19	257.96	950	262.31	937.81	271.19	929	255.643	921.67	254.75
IG urine output	0	0	2.45	1.00071	3.5883	1.7926	4.5455	2.157	4.1154	1.3322	3.78	0.99009	5.2467	1.6535
CG urine output	0	0	1.9408	0.76542	3.4514	1.4851	3.975	1.1608	4.2133	1.7832	4.6818	2.09705	4.3727	1.3646
IG 1st blood glucose measurement	106.73	42.819	110.2	64.078	96.95	36.883	85.95	26.995	98.43	27.299	105.24	32.828	145.57	199.53
CG 1st blood glucose measurement	112.79	34.399	128.21	83.736	93.14	37.442	106.76	42.43	96.995	32.339	98.95	21.423	118.71	71.335
IG 2nd blood glucose measurement	123	58.549	112	41.847	90.85	33.878	93.84	25.244	138.5	153.21	97.32	31.667	104.95	22.421
CG 2nd blood glucose measurement	123.53	71.771	125.8	95.267	97.83	38.698	95.8	36.713	103.42	41.946	94.94	23.379	94.38	31.513
IG 3rd blood glucose measurement	117.4	29.103	102.82	43.112	95.77	39.389	110.53	33.276	110	28.837	106.32	30.75	109.67	27.5
CG 3rd blood glucose measurement	142.56	80.37	145	71.932	124.53	67.992	119.88	36.558	104.29	17.431	110.55	43.69	110.44	25.771
IG water quota	74.33	11.52	109.72	9.773	89.85	11.582	97.05	12.044	98.89	20.762	112.06	10.164	122.56	15.317
CG water quota	84.82	26.161	88.85	28.781	90.98	13.925	10.61	17.584	106.39	16.252	114.74	12.999	121.16	21.729
IG 1st urine density measurement	11011	4.768	966.52	199.959	1010.1	1.179	1011.2	3.516	1010	3.17	1011.4	3.682	1010	2.539
CG 1st urine density measurement	1008.7	4.026	1011.5	4.708	1015	7.57	1013.4	5.586	1013.2	4.918	1471.5	2056.84	1011.2	4.207
IG 2nd urine density measurement	0	0	1011.7	7.329	1011.1	4.066	1012.7	4.933	1012.6	5.781	961.06	226.21	1011.2	3.498
CG 2nd urine density measurement	0	0	1011.1	4.39	1014	6.28	1015.8	11.844	1012.3	4.52	1012	4.223	1017	24.161
IG 3rd urine density measurement	1008.1	7.106	1010.9	2.293	1009.7	4.212	1012.5	4.186	1011.8	5.513	1012.4	3.884	1011.2	4.223
CG 3rd urine density measurement	1010.4	4.534	1011.6	9.573	1015.2	4.847	1014.2	5.364	1012	4.79	1022.8	45.452	1011.5	3.137
IG sodium	132.58	4.525	140.35	7.714	137.48	11.682	140.6	7.632	138.55	7.331	137.45	5.236	137.29	10.1
CG sodium	133.8	7.599	137.53	5.551	142	9.68	144.56	12.837	143.55	12.245	142.65	11.446	140.37	8.001

Both groups presented similar average and standard deviation concerning urine output over the week: the IG presented an average of 3.6 and standard deviation of 1.8, while the CG had an average of 3.4 and standard deviation 1.5. At the end of the fifth day, the groups presented averages of 4.1 and 4.2 and standard deviation of 1.3 and 1.7, respectively.

The statistical results concerning the variable blood glucose collected three times a day revealed a greater stability in the IG in comparison to the CG, as shown in Table 1. The average of the third measure of the first day of the IG was 117.4 and of the CG was 142.6. The average of the first measurement of blood glucose in the second day for the IG was 110.2 and for the CG was 128.2. The second measurement of the second day of the IG was 112 and for the CG was 125.8. The average of the third measure of the second day for the IG was 102.8 and the CG was 145. The average of the third measure of the third day for the IG was 95.8 and the CG was 124.5. The averages of blood glucose at the end of the seventh day were 110.8 for the IG and 134.6 for the CG, meaning that the CG presented a greater blood glucose change over the period.

The IG was more balanced in relation to water quota than the CG. The average was 74.3 for the IG in the first day while it was 84.8 for the CG. In the fourth day, the IG average was 97.0 and the CG was 110.6. In the fifth day it was 98.9 and 106.4, respectively. The groups' averages at the end of the week were 59.5 and 70.2 respectively. The analysis of the averages of urine density for each day for both groups indicates that on the fourth day an important change occurred. The average for the IG was 1,010 with a standard deviation of 2.4 and 1,014 for the CG with a standard deviation of 5.2 ($p=0.003$). Hence, it is worth noting that the IG was more homogeneous than the CG concerning urine density since its variation was from 1,008 to 1,012 while the CG varied from 1,009 to 1,019.

Table 2 presents the results of regression analysis for weight, urine output, blood glucose, water quota, urine density and sodium in PTNBs from both IG and CG where *a* represents the coefficient of linear regression equation, *b* is the angular coefficient and *p* refers to level of statistical significance.

The results distributed in this table show a daily decrease of 20g in the IG (p = 0.037) and 18g for the CG, though not statistically significant (p = 0.094). In relation to urine output, data revealed a statistical significance for both groups at the end of the seventh day (p = 0.001). Blood glucose values decreased 1.2 for the IG and 5.3 for the CG. Hence, the CG presented 4.4 times more hyperglycemia episodes over the course of the seven days than the IG. P values were 0.524 and 0.025 respectively.

The results concerning the water quota present a regression of 7.220 for the IG and 6.094 for the CG. Both the groups presented statistically significant results (p = 0.0001). In relation to urine density, the IG presented a slight decrease of 0.777, while the CG presented a daily increase of 22.892, that is, this group presented a higher urine density than IG over the course of seven days (p= 0.717 for IG and p= 0.127 for the CG). The IG had an increase of 0.603 of sodium and CG had an increase of 1.835. The PTNBs in the CG had three times more chance of having hypernatremia than those in the IG over the seven days. Both groups presented statistical significance (p = 0.0001).

DISCUSSION

Weight control, sodium, water balance and blood glucose are essential in order to evaluate transpidermal water loss as shown in this study. Monitoring these measures is relevant because they indicate the health conditions of newborns and also their responses to the treatment established in the NICU, keeping in mind that the hospitalized newborns were kept in non-humidified incubators.

In general, various factors can alter the rate of water evaporation through skin: its thickness and structure, the content of the epidermis, and environmental humidity. Exposure to a dry environment can promote the maturity of the skin as well as the use of a non-humidified incubator with an internal temperature between 34°C and 36°C.

Exposure to the extra uterine environment shows a positive effect on the maturation of skin, though PTNBs frequently present hyperosmolarity during the first days of life when they are exposed to high temperature incubators. Nonetheless, it is not clear whether transpidermal water loss is explained only by skin immaturity or whether other mechanisms facilitating water transportation are involved. Hence, it is important to assess such transpidermal loss and also implement interventions to reduce the risk of transpidermal loss and its complications(3).

According to Table 1, the CG showed a greater need for water replacement according to the averages recorded: 60 for IG and 70 for the CG (p = 0.0001). Water transpidermal loss is responsible for 20% of energy spent by newborns younger than 30 weeks(7). Water loss occurs after birth as a result of diverse mechanisms, among them through the renal system, that are jointly called *insensible loss* and they work through the respiratory system, feces and skin (transpidermal). This transition is hindered, especially among PTNBs, given the immaturity of organic systems and the small amount of knowledge concerning certain aspects of fetal physiological development. Hydro-electrolytic disorders in newborns, especially in extremely premature neonates, contribute to neonatal morbidity and mortality(8).

Knowledge concerning factors that influence transpidermal water loss is essential to estimate the water needs of newborns and appropriately adjust the administration of fluids with changes in care(9). No important changes were implemented during this study to replace water in the preterm newborns in the IG. This mainly occurred due to the use of the semipermeable membrane, a positive factor for water maintenance in PTNBs in the IG, keeping in mind that these infants did not use humidified incubators.

The replacement of fluids is performed daily according to the hydroelectrolytic needs of PTNBs. This replacement, called water quota, should be performed with caution to avoid circulatory overload. Such control was implemented for newborns in both the IG and CG during the course of the seven days. This state of relative oliguria differs according to prematurity. It may lasts 20 hours in full term newborns and up to 96 hours in preterm newborns, more precisely in neonates with asphyxia or with respiratory distress(8). The averages of urine output from the second day of both groups were within normal standards; there was statistical significance between the average values of the groups (p= 0.0001).

The transpidermal water loss causes complications such as hypernatremia, defined as plasma sodium greater than 150 mEq/l, estimated to affect 10% to 15% of newborns in intensive care. Additionally there was potential neurological morbidity related to plasma hyperosmolarity with a risk of peri-intraventricular hemorrhage(10).

Other studies used devices to measure transpidermal water loss such as the evaporimeter known as the Tewameter device, which consists of a cylindrical probe of two hydrosensors built and designed to measure the rate of water evaporation from the skin and which is positioned 3 to 9mm of distance from skin(11). We did not use this device in this study to collect precise results in relation to water loss in each group. However, we evaluated loss of fluids through body weight control, urine output, water quota, urine density, blood glucose and sodium over the course of the seven days.

The semipermeable membrane can work as an artificial skin barrier right after birth to prevent excessive water loss through evaporation. This measure is extremely important because it helps to prevent dehydration, hyperhydration, hypernatremia and also heat loss, so common among the neonatal population(1). The semipermeable membrane was used in the PTNBs from the IG, which in addition to the properties already mentioned (epidermal barrier, reducing agent of transpidermal loss that acts in hydroelectrolytic control), was also a protection factor directly related to skin integrity and consequently the PTNBs' quality of life.

Studies performed in NICUs show that the semipermeable membrane is beneficial to skin and consequently to the infant's health. It is a technological advancement available in neonatal units and contributes to newborns' full and timely recovery. For a higher efficacy of this membrane, nursing professionals need to be sensitized to perform a reflexive practice guided by scientific knowledge and individualized care[12].

An experimental study showed that when PTNBs have a semipermeable membrane applied, they are at a lower risk of developing hypernatremia (sodium $\geq$ 150 Meq/l) during the entire first week of life than those not using the membrane over the skin. The pellicle is a thin, semipermeable membrane of polyurethane and self-adhesive in one of the sides, which when applied to the newborn's skin, significantly reduces transpidermal water loss without interfering with the skin's integrity and natural development[2]. These findings are in agreement with those found in this study.

Another point to be highlighted is an incapacity to metabolize glucose that may occur in PTNBs or secondarily in the presence of septicemia or stress. PTNBs frequently become hyperglycemic when receiving parenteral nutrition because they are not able to tolerate the increased level of glucose. Hyperglycemia is defined as plasma glycemia above 125mg/d[13]. Hyperglycemia episodes are more frequent among preterm infants due to the excessive supply of glucose, immaturity of glucose regulatory systems and increased levels of circulating stress-related hormones (catecholamines and cortiosteroids) [14].

In the analysis presented in Table 2, the PTNBs from the CG presented more episodes of hyperglycemia in relation to the IG. Given skin cornea immaturity, the PTNBs are subject to a syndrome characterized by hypernatremia, hyperglycemia and dehydration in the first week of life[8]. The CG received a greater water quota than the IG, which contributes to a greater supply of glucose. The IG, due to the use of semipermeable membrane, received a lower water quota. Consequently, a lower glucose supply resulted in fewer episodes of hyperglycemia for the IG.

Therefore, we corroborate authors[15-16] who emphasize the importance of associating technological resources with humanized care. More specifically, the use of the semipermeable membrane with PTNBs as a technological nursing strategy aimed to achieve improved quality of care in the survival, development and wellbeing of newborns and their families.

CONCLUSION

Applying semipermeable membranes right after birth improved the maintenance of sodium, water quota, urine density and glucose among newborns. The CG presented more hypernatremia episodes, higher urine density, hyperglycemia and needed greater daily water replacement. This study also provides evidence that the IG maintained a more stable clinical condition in relation to these variables.

The PTNBs in the IG showed reduced levels of sodium and daily fluid requirements in the first week of life with the application of the semipermeable membrane immediately after birth. These infants also presented fewer hyperglycemia episodes and urine density was kept within normal standards in comparison to the CG. In relation to duration of hospitalization, the IG newborns recovered earlier than those in the CG. Hence, the use of the semipermeable membrane is recommended to ensure the clinical stability of preterm newborns hospitalized in NICUs.

It is worth noting that the lack of humidified incubators in the studied facility represents a limitation on this study, as does the unit's routine of using a standard temperature within incubators between 34ºC and 36ºC. It is known that these elements contribute to the maintenance of newborns' thermal comfort, reducing, at a minimum, the production of heat, oxygen consumption, nutritional needs for growth and also minimizing transpidermal water loss. Given these findings, the recovery of the PTNBs reflect the efficiency of the semipermeable membrane and quality of care provided by the interdisciplinary team from the NICU.

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Correspondence addressed to: Eloah Pessoa Gurgel
Rua Afonso Pena, 155 - Casa 01 - Bairro Édson Queiroz
CEP 60834-522 - Fortaleza, CE, Brasil