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Original Article

URINARY DENSITY MEASUREMENT AND ANALYSIS METHODS IN NEONATAL UNIT CARE

MÉTODOS DE MEDIÇÃO E ANÁLISE DE DENSIDADE URINÁRIA EM RECÉM-NASCIDOS NA UNIDADE NEONATAL

MÉTODOS DE MEDICIÓN Y ANÁLISIS DE DENSIDAD URINARIA EN RECIÉN NACIDOS EN UNIDAD NEONATAL

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The objective was to assess urine collection methods through cotton in contact with genitalia and urinary collector to measure urinary density in newborns. This is a quantitative intervention study carried out in a neonatal unit of Fortaleza-CE, Brazil, in 2010. The sample consisted of 61 newborns randomly chosen to compose the study group. Most neonates were full term (31/50.8%) males (33/54%). Data on urinary density measurement through the methods of cotton and collector presented statistically significant differences ($p<0.05$). The analysis of interquartile ranges between subgroups resulted in statistical differences between urinary collector/reagent strip (1005) and cotton/reagent strip (1010), however there was no difference between urinary collector/ refractometer (1008) and cotton/ refractometer. Therefore, further research should be conducted with larger sampling using methods investigated in this study and whenever possible, comparing urine density values to laboratory tests.
Descriptors: Infant, Newborn; Neonatal Nursing; Intervention Studies; Urinary Reservoirs, Continent.

Objetivou-se avaliar os métodos de coleta de urina algodão em contato com a genitália e coletor urinário na realização da densidade urinária em recém-nascidos. Estudo de intervenção, quantitativo, junto a 61 recém-nascidos escolhidos de forma não probabilística. Realizado em unidade neonatal de Fortaleza-CE-Brasil, 2010. A maioria dos neonatos nasceu a termo (31/50,8%) e sexo masculino (33/54%). Os dados da medição da densidade urinária com algodão e coletor demonstraram diferença estatisticamente significante ($p<0,05$). A análise dos intervalos interquartílicos entre os subgrupos resultou em diferença estatística entre, coletor urinário/fita reativa (1005) e o algodão/fita reativa (1010), contudo não ocorreu diferença entre o coletor urinário/refratômetro (1008) e algodão/refratômetro (1008). Novas pesquisas merecem ser executadas com amostragens maiores utilizando os métodos aqui propostos e se possível, correlacionar os valores obtidos com exame laboratorial.
Descritores: Recém-nascido; Enfermagem Neonatal; Estudos de Intervenção; Coletores de Urina.

El objetivo fue evaluar el método de recolección de orina algodón en contacto con la genital y colector urinario para realización de la densidad urinaria en recién nacidos. Estudio de intervención, cuantitativo, con 61 recién nacidos seleccionados de manera no probabilística. Llevado a cabo en unidad neonatal de Fortaleza-Ceará, Brasil, en 2010. La mayoría nació a término (31/50, 8%) y sexo masculino (33/54%). Los datos de medición de la densidad urinaria con algodón y colector señalaron diferencia estadísticamente significativa ($p<0,05$). El análisis de los intervalos interquartilicos entre los subgrupos resultó en diferencia estadísticamente significativa entre colector urinario/cinta reactiva (1005), algodón/cinta reactiva (1010), pero no fue identificada diferencia significativa entre colector urinario/refractómetro (1008) y algodón/refractómetro (1008). Nuevas investigaciones merecen ser ejecutadas con mayor muestreo, utilizando los métodos propuestos y, si posible, relacionar valores obtenidos con examen de laboratorio.
Descriptores: Recién nacido; Enfermería Neonatal; Estudios de Intervención; Reservorios Urinarios Continentes.

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INTRODUCTION

The number of newborns (NB) in Neonatal Care Units (NCU) is constant and neonatal mortality rates are still high[1]. In order to help these newborns survive, it is necessary to perform routine care practices such as laboratorial tests, blood samples for arterial gasometry, complete hemogram, reactive C protein, blood typing, Rh factor, urea, creatinine, electrolytes, bilirubin, glycemia and urinary density.

Urinary density (UD) is a typical parameter for NB hydration evaluation. Normal values vary between 1015 and 1020, although they can have strong physiological variations depending on higher or lower fluid intake[2].

The collection of this test is the responsibility of the nursing professional. Personal hygiene is the first step, to then insert the urinary collector or cotton swab in contact with the NB genitalia. After urine presence is verified, the UD measurement is performed. In the neonatal unit, test results may be evaluated in two different ways: through the leaking of urine into the refractometer or applying a reactive strip that measures several urinary parameters such as the presence of glucose, nitrite and urinary density[3].

In Brazil, no Nursing research has been found with regards to the use of cotton as a collection method, however in the United States it is a common found practice in pediatrics[4]. Therefore, based on Neonatal Nursing practices and the lack of studies on Brazilian newborns and children, we question the following: is there any UD difference when collecting urine with cotton and urinary collector compared to the use of reactive strip and refractometer?

The answers to these questions may encourage further study on interventions that use wet cotton or urinary collector for UD tests in newborns. Besides, it is important to perform research on this topic, seeking that Nursing can measure UD based on scientific knowledge, which shall definitely contribute to better NB care practices.

We also sought to evaluate the use of the collection methods of cotton in contact with genitalia and urinary collector in urinary density tests for newborns and the analysis methods of reactive strip and refractometer, comparing UD methods with the use of cotton in contact with genitalia and urinary collectors, using as testing parameter the reactive strip and the refractometer.

MATERIALS AND METHODS

This is an intervention study of exploratory and quantitative nature in which participants were considered in a non-probabilistic fashion to compose the study group, which was developed at the Neonatal Care Unit (NCU) of a public institution in Fortaleza-CE, between April and May 2010.

Research participants were newborns hospitalized at the NCU in the middle and low risk sectors, regardless of their diagnosis, gestational age and hospitalization time. The sample was arranged in consecutive order, totalizing 61 newborns. As middle risk units had 30 beds, we estimated that nearly 90% of hospitalized newborns might sometime need to be UD tested, which set the sample size.

Data collection was carried out by researchers in both the day and night shifts, being recorded in a form divided in two parts. The first part includes variables extracted from NB clinical records that permit to identify the patient profile in terms of birthdate, gender, birthweight, birth conditions, gestational age, birth type and delivery method, as well as the weight on the UD test day, besides treatment modalities (phototherapy, oxygen therapy, diet type, venous hydration, antibiotics therapy). The second part includes the UD measurement method, date, method used (cotton or urinary collector) time and UD value identified in the reactive strip and in the refractometer for each method).

Two urine collections were used for each newborn, observing handling hours established by the NCU routine, being one of them made with cotton and the other one through urinary collector. Then, each urine sample was analyzed by the reactive strip and by the refractometer. The same shift was used for both methods with the smallest collection time interval possible, seeking to avoid research bias with regards to possible NB clinical and hydration alterations.

For data collection, the following materials were used: cotton, disposable syringe plastic cover, which was used for cotton protection when in contact with the NB genitalia; child urinary collector without adhesive removal, seeking to reduce skin lesion risks; reactive strip adopted by the institution, refractometer and distilled water ampoule for refractometer calibration.

In order to organize data, newborns were divided into four study groups: the first one for urinary density collection measurement methods (collector and cotton) and the second for urinary density analysis methods (refractometer and reactive strip). The distribution was assigned as follows: group 1: newborns who used Collector/Reactive strip x Cotton/Reactive strip and group 2: newborns who used Collector/Refractometer x Cotton/Refractometer. Group 3 was composed by newborns that used cotton/reactive strip x cotton/refractometer and group 4 by newborns that used collector/reactive strip and collector/refractometer.

Data related to NB identification was introduced in a descriptive way, seeking to qualify them in terms of gender, birthdate and during test, gestational age, use of antibiotics, hydration and phototherapy. Data related to the evaluation of the urine collection method applied for urinary density testing through cotton and urinary collector and analysis through reactive strip and refractometer was introduced in charts. It is worth highlighting that the Excel program was used for data organization, and the Software Statistical Package for the Social Sciences - SPSS version 18 was applied for data analysis. Descriptive statistics were used through simple and absolute frequency, dispersion measures and central tendency. For analysis of UD values and referred methodologies, the Wilcoxon test was applied. Interquartile ranges of the subgroups collector/reactive strip, cotton/reactive strip and collector/refractometer x cotton/refractometer were calculated to verify differences to then compare obtained results with the relevant literature, which resulted to be very limited. A significance level of 0.05 was established for the test.

Previous authorization to perform this work was granted through protocol nº 014/10, issued by the Ethics and Scientific Commission of the researched institution. NB parents/caregivers signed an Informed Consent Agreement authorizing participation in the study.

RESULTS

33 of the participating newborns were males and 28 females. As for their delivery method, 30 were born through cesarean delivery (49.1%), 28 through vaginal delivery and three (4.91%) through forceps. Gestational age varied from 37 to 42 weeks (classified as term) totalizing 51 newborns (50.8%), followed by 31 to 34 weeks (moderate preterm) with 19 births (31.1%). 10 babies were born between the 35 and 36 week (16.3%) and qualified as borderline preterm; those born on the 42 week or later represented the smallest percentage (1.6%) and they were classified as post-term.

With regards to their weight 32 (53.3%) weighed more than 2.500 kg; 23 (38.3%) weighed between 1.500 and 2.499 kg and five (8.3%) weighed between 1.000 and 1.499. As for the weight of newborns at the moment of UD testing, 32 (53.3%) continued to weight more than 2.500 kg (within normality standards) whereas 27 of them (45%) weighted between 1.500 and 2.499 (low weight). The growth in this group was related to the weight gain of four newborns that had very low weight at birth, out of which only one of them

continued to keep such a low weight level afterwards.

As for the antibiotics therapy administered to the newborns, 25 (40.9%) were taking antibiotics whereas 35 (57.3%) were not. However, 17 of them (27.8%) needed venous hydration. Phototherapy was applied to 45 babies (73.7%), being that 13 of them (21.3 %) received phototherapy with halogens (*spot*) and four (6.5 %) were applied bilispot or reflexive phototherapy.

Next, central tendency and perinatal dispersion variables in studied newborns considered relevant by the authors are introduced.

Table 1 – Gestational age, birthweight and current weight of urinary density tested newborns. Fortaleza, CE, Brazil, 2010.

Variables	Mean±SD	Median	Min.	Max.
IG (Weeks)	36.77 ± 2.8	37.1	31.2	42.5
Weight (Grams)	2655.9 ± 832.6	2544	1030	4835
Current weight (Grams)	2680.6 ± 746.7	2527.5	1450	4755

In Table 2, comparative data between study groups for urinary density collection methods and evaluation through reactive strip and refractometer is introduced.

Table 2 – Comparison between study groups for collection methods (collector and cotton) and urinary density measurement (refractometer and reactive strip). Fortaleza, CE, Brazil, 2010.

Collection method/measurement	Median	Min.	Max.	p*
Group 1				
Collector/Reactive strip x Cotton/Strip	1005	1000	1020	0.010
Group 2				
Collector/Refractometer x Cotton/ Refractometer	1008	1000	1024	0.030
Group 3				
Cotton/Reactive strip x Cotton/refractometer	1008	1000	1022	0.702
Group 4				
Collector/Reactive strip x Collector/Refractometer	1006	1000	1024	0.556

* Wilcoxon test. p<0,05

In Table 3, interquartile range data for the study subgroups is entered, seeking to understand differences among them.

Table 3 – Interquartile range for study subgroups. Fortaleza, CE, Brazil, 2010.

Collection/measurement methods	Quartile 1 (n=61)	Quartile 2 (n=61)	Quartile 3 (n=61)	Quartile 4 (n=61)
Urinary collector/Reactive strip	1005	1005	1010	1015
Cotton/ Reactive strip	1005	1010	1010	1020
Urinary collector / refractometer	1006	1008	1010	1024
Cotton/refractometer	1006	1008	1010	1022

DISCUSSION

Before specifically demonstrating data related to the use of collection methods and urine analysis for UD, we opted for emphasizing aspects that permeate NCU assistance related to the importance of urine evaluation and how it affects newborn health. The countless daily procedures to which newborns are subject by the NCU team, which include blood and urine extraction for urinary density may provoke stress and pain, which

unleash a biopsychological unbalance[5-6]. That is why these patients need to receive specialized care by health professionals, who should offer a comprehensive and humanized assistance[7-9].

The procedure to perform urinary density testing is simple and non-invasive and has been carried out in clinical practice for years[3]. It is the Nursing team responsibility to measure UD in newborns according to medical prescriptions, being possible to obtain it through urine collection through cotton or urinary collector. However, some precautions are necessary, both in the technique and in the interpretation of results. For example, cotton/and or the urinary collector should not contain feces or ointments applied to the newborn, as they may alter urinary density values. In sample contamination situations, it is necessary to perform prior sanitation to then carry out a new test, which should be analyzed immediately after collection.

As for the advantages of these collection methods, we remark the low-cost of cotton, which is also non-irritant for the NB skin, accessible for urine collection and more practical to insert in the NB due to its small size and quantity required for collection purposes, as it only protects the NB genitalia. Besides, the plastic material that coves the cotton is adapted to the sterile packaging of disposable syringes, provided hygiene conditions are observed. This way we can make sure all skin prevention norms are respected, thus protecting the NB health. With the urinary collection method we have the advantage of observing urine features such as volume, aspect and color, which is not possible with cotton. However, a small amount of urine may be directly aspired from diapers through a needleless syringe. Should diaper jelly be used, gauze and cotton balls must be applied for urine use[10].

Nursing research shows urine samples collected through the cotton ball method are perfect for PH and urinary density, as it is a practical, low-cost method and it's also not traumatic for the newborn skin[4]. Among the main disadvantages of these collection methods we must mention the use of a plastic protector around the cotton in order to avoid urine leaking, as in clinical practice we perceive the improvisation in the use of this plastic. When used incorrectly, it may cause irritation or even lesions in and around the groin area. With the use of a collector, the cost is higher and the adhesive in direct contact with the skin may also provoke irritation or even wounds, besides the problem of the collector bag, which does not cover just the genitalia but also other adjacent body areas. We must also highlight the need to look after the NB skin, as the collective bag strip, due to the friction provoked by placing it and removing it several times a day, may produce lesions in the delicate NB skin. As the NCU has different routines in order to help the NB survive, damage such as NB skin lesions may appear[11]. Both the collector and the cotton may be displaced if not adequately placed for the diaper to remain firm and correctly adapted, thus allowing urine to leak or mix with feces, making the collection unusable[10].

During urinary density measurement, when applying the reactive strip measurement method, it must be considered that the obtained result depends much on the observer, as distinguishing the strip result color to compare it with colors as labeled in the bottle is necessary in order to be accurate. Therefore, this observation is somehow subjective as color tones may be sometimes confusing, which will make the result dependant on the observer's subjective vision. Sometimes the result is within value ranges. The evaluator shall make the decision, oftentimes the nurse or another member of the nursing team.

Density helps evaluate filtration and renal concentration functions, as well as the body hydration state. This depends directly on the proportion of present urinary solutes (chloride, creatinine, glucose, phosphates, proteins, sodium, sulphates, urea, and uric acid) and the water volume, which normally varies between 1.010 e 1.020[3].

Seeking to keep adequate fluid debit and hydration, fluid intake must be frequently evaluated and compared to urinary debit. Term newborns require a fluid intake amount between 140 and 160 ml/kg per day to stay hydrated. This need increases in case of disease, preterm birth, excessive evaporation or fluid loss due to radiation. Preterm newborns may be kept with 80 to 120 ml/kg of fluids per day if dehydration signs are observed. Urinary debit shall be from 1 to 2 ml/kg per hour. During the first 24 hours after birth, the newborn may only urinate once or twice, although the debit of these two urinations may exceed that of later ones[2].

Any condition that may interfere in the normal water and electrolyte intake or that may provoke their excessive loss shall result in faster water and electrolyte reserve losses in newborns than in adults. Disease, increase in muscular activity, temperature alterations, congenital anomalies and respiratory distress syndrome can also affect metabolic demand[12]. The nursing team needs to pay attention to these alterations, as they may interfere with the NB hydration and consequently affect urinary density.

It is important to remark that initially, urine can be blurred and yellowish due to the presence of urinary protein, blood and mucus; density must measure between 1.005 a 1.015. A urinary density above 1.025 may suggest fluid retention, unless the newborn has been dehydrated[3]. Based on this data, most newborns studied presented an UD within normal parameters, did not have bloody looking or blurred urine, nor presented any other abnormality. This was possible to identify through the extraction made with the collector, as one of its advantages is the naked eye evaluation of urine volume, aspect, color and smell.

Results suggest that UD values found by the two collection methods (collector and cotton) in most cases did not present values that could compromise NB clinical evaluation. There was equivalence among obtained results. When comparing values for the study groups (1 and 2) both stayed within their median of 1005 and 1008 respectively. In other words, urinary density was stable and normal throughout the study, without significant differences between groups and within normal parameters. Consequently, there were no discrepant results between both methods. The p value showed a statistically significant difference ($p<0.05$) when analyzing the collection method for group 1 - collector/reactive strip x cotton/reactive strip with $p= 0.010$ as well as in group 2 for collector/refractometer x cotton/refractometer with $p= 0.030$. Therefore, both collection methods can be considered to be equivalent.

A non-controlled clinical study with a sample of 26 preterm babies intended to verify osmolarity and urinary density in newborns, which resulted in no significant differences in the evaluation of the different collection methods[13].

Research results with emphasis in the urinary measurement methods (refractometer and reactive strip) demonstrated that group 3 (newborns who used cotton /reactive strip x cotton/refractometer) and group 4 (collector/reactive strip and collector/refractometer), had equivalent results. Values for each group (3 and 4) were on average 1008 to 1006 respectively, that is to say, within normality parameters. Consequently, no discrepant results between both methods were found. In the p value there was no significant statistical difference ($p<0.05$) with $p = 0.702$ in group 3 and $p= 0.556$ in group 4.

Continuing with the analysis, seeking to understand differences among subgroups (urinary collector/reactive strip, cotton/reactive strip and urinary collector/refractometer and cotton/refractometer) we perceive through table 3 data that considering interquartile ranges of each subgroup, there is no difference in quartiles 1 and 3, however quartile 2 showed a slight difference in urinary collector/reactive strip (1005) and cotton/reactive strip (1010) but there was no difference in the subgroup urinary

collector/refractometer (1008) and cotton/refractometer (1008). UD evaluated by the refractometer did no present any differences whereas the reactive strip did. To corroborate research results, specialist in the subject explain that reactive strips make fast urine analysis much easier, however this method is not entirely reliable due to the action of chemical reagents, room temperature, time and amount of urinary collection[14].

A comparative study on urinary density made with 30 children used the method of cotton balls inserted in the baby's urinary meatus, as well as an additional urine collection extracted from diapers. The labstik reagent strip was used for evaluation. Results for both methods were equivalent in both samples. No redness or wounds in the children's skin were noticed. This study also compared urine samples collected in two different types of disposable diapers and found significant differences in PH and urinary density. This was not the case when compared to the cotton balls method[4]. This study helped to corroborate results obtained in this research.

CONCLUSIONS

When urinary density was measured through the application of cotton in contact with genitalia and urinary collector in 61 newborns, no median discrepant results were found. There was also no significant p value difference ($p<0.05$) with $p = 0.702$ in group 3 and $p= 0.556$ in group 4. Consequently, these analysis methods cannot be considered equivalent.

When analyzing the urine collection methods collector and cotton, p values were statistically significant when the collection method was evaluated (groups 1 and 2) showing equivalence between them.

These values were more evident when calculating interquartile ranges for each study subgroup (urinary collector/reactive strip, cotton/reactive strip, urinary collector/refractometer and cotton/refractometer. Results suggest that there is no difference between collection methods, however there is a considerable difference with regards to the analysis methods.

This study has largely contributed to the nursing science and newborn health as it perform a strict analysis of UD verification practices in hospitalized newborns following a scientific methodology. Study results confirm that UD verification through different collection methods such as urinary collection or cotton may be considered similar collection methods, however it is important to remark that before making the methodology choice, adequate clinical practices must be observed, as authors corroborated in their routine work that the first option of choice is usually cotton and urinary collector, as it is considered low-cost and practical. This method is delicate, as it may contain feces or other materials (blood) besides requiring very careful attention in the case of cotton verification, especially during the urine impregnation stage. The urinary collector requires careful fixation to the NB genitalia.

Further research on the subject should be carried out with larger samples for the cotton method and whenever possible, correlating urinary density values with more accurate tests such as laboratorial exams, seeking to offer a better newborn care and assistance.

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