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Urinalysis in Clinically Stable Nigerian Newborns

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Summary

Adedoyin OT, Akindele JA, Ajayi OA, Okesina AB. Urinalysis in Clinically Stable Nigerian Newborns. *Nigerian Journal of Paediatrics* **2000**; **27**: **1**. Urinalysis, using the multistix strip, was carried out in 80 clinically stable normal newborns comprising 60 pre-term and 20 term babies. Glycosuria was not identified in any baby. All the term babies had 1+ proteinuria while proteinuria of 1+ or 2+ was recorded in 42 (70 percent) of the 60 preterm babies. The mean urine pH in the preterm babies was 6.7 as against 5.7 in the term babies ($P<0.001$). The findings in this study suggest mild proteinuria in early neonatal period and negative correlation between urinary pH and gestational age.

Introduction

URINALYSIS using the multistix strip, is a simple and quick screening test to detect the presence of glucose or protein in the urine of an infant. It can also be used in the determination of urinary pH. Proteinuria and glycosuria in the newborn are important indicators of the presence or absence of renal pathologies such as congenital nephrotic syndrome or renal glycosuria. Determination of the urinary pH also helps to assess the newborn infant's ability to excrete an acid load, hence, it aids in the diagnosis of renal tubular acidosis. Studies on urinalysis for protein, glucose and pH in the newborn infant have been carried out mostly in Caucasians living in temperate regions[1,2] and the findings from these studies have been used as reference guide for the black newborn who may live under different climatic conditions. In this prospective study, urinalysis was carried out for protein, glucose and pH using multistix strips in clinically stable Nigerian newborn babies at 48-72 hours of life.

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Materials and Methods

This prospective study was carried out between November 1993 and October 1994 in the Department of Paediatrics and Child Health, University of Ilorin Teaching Hospital. Although the hospital catchment population consists mainly of patients from within the urban city of Ilorin, patients are also referred by private and government general hospitals and dispensaries from within the metropolis and other parts of the country especially the neighbouring states.

The study population consisted of 80 clinically stable appropriate for gestational age (AGA) newborn babies of various gestational ages, admitted to the Neonatal Intensive Care

Unit (NICU) and babies in the lying-in ward of the maternity wing of the hospital. The inclusion criteria were:

1. Absence of proven or clinical features suggestive of septicaemia
2. Absence of birth asphyxia, as determined by an Apgar score of >6
3. Absence of polycythaemia (venous haematocrit >65), neonatal hyperbilirubinaemia occurring in the first 24 hours of life or high enough to require exchange blood transfusion, and respiratory distress severe enough to require oxygen
4. Absence of palpable kidney
5. Non-administration of theophylline, frusemide, bicarbonate and parenteral fluid.

The 80 newborns were randomly selected in a systematic fashion choosing alternate babies in the same gestation group, in such a way that if a baby of 32 weeks gestation was chosen, the next one of the same gestation will not be chosen, but the one after this will be chosen, despite all of them satisfying the inclusion criteria. Thus four groups of twenty babies in each group were constituted in this fashion. The gestational ages of those selected were determined by the Ballard scoring system. They were assessed on a daily basis in order to verify the absence of any development that might be contrary to the inclusion criteria; the assessment also included the determination of the packed cell volume once between 48-72 hours of life when the urine was collected. The urine specimens were obtained in male babies by strapping improvised urine bags to the phallus, while the specimens were collected by suprapubic aspiration in the females; this was done to ensure freshness of urine used in multistix assessment for protein glucose and pH as freshness of urine from wet nappy cannot be guaranteed. It was also aimed at overcoming the problem of getting suitable urine bags for females. Urinalysis for protein, glucose and pH was carried out using the medi-test combi 3A test strip (*Macherey Nagge D-5160 Duren*). The reagent strip was dipped for approximately one second into the freshly collected sample of urine; it was then drawn across the rim of the container to remove the excess urine. The test strip colour was compared within 30-60 seconds, with the colour scale and the value of each estimation recorded. The colour fields corresponded to the following ranges of albumin concentrations – negative (0mg/dl), 1+ (30mg/dl), 2+ (100mg/dl) and 3+ (500mg/dl). The colour fields for glucose corresponds to the following ranges of glucose concentrations: negative (yellow), 1+ (50mg/dl, 2.8mmol/l), 2+ (150mg/dl, 8.3mmol/l), 3+ (500mg/dl, 27.8 mmol/l) and 4+ (1000mg/dl, 55.5mmol/l). For the pH estimation, the test paper contained indicators which clearly changed colour between pH 5 and 9 (from orange to turquoise).

Routine care of the babies such as feeding, continued but none of the babies was on parenteral fluid. All the term babies were breast-fed on demand. Preterm babies of 34 weeks gestation and above, were mostly on expressed breast milk (EBM) 60ml/kg/day and increased by 15ml/kg/day while some were breast-fed on demand. Those of 32-33 weeks' gestation were receiving EBM 60ml/kg/day by cup and spoon and this was increased by 15ml/kg/day; babies less than 32 weeks gestation were on EBM 60ml/kg/day by orogastric feeding and increased by 15ml/kg/day. Institutional approval and verbal parental consent were obtained for the study.

The percentages of each grade of proteinuria in both preterm and term babies were computed. The mean, standard deviation and range of urinary pH in both preterm and term babies were also computed. Kruskal Wallis one way analysis of variance, a non-parametric test, was used for comparison of urinary pH among preterm and term babies. The influence of gestational age on urinary pH was assessed by using the Spearman's rank correlation coefficient. A p value of <0.05 was considered statistically significant.

Results

A total of 60 preterm and 20 term AGA

neonates were studied. They comprised 49 (61.2 percent) males and 31 (38.8 percent) females

Table I

Gestational Age and Sex Distribution in 80 Neonates

Gestational Age (weeks)	Male	Female	Total
≤32	13	7	20
33-34	14	6	20
35-36	7	13	20
≤37	15	5	20
Total	49	31	80

(Table I). There were 20 babies each, in the following gestational age ranges: =32 weeks, 33-34 weeks, 35-36 weeks and =37 weeks (Table I). Table II shows the anthropometric indices according to gestational age groupings

There was no glycosuria in any of the urine samples. Eighteen (90 percent) of the babies in the =32 weeks group had 1+ proteinuria while two (10 percent) had 2+ proteinuria. Ten (50 percent) of the babies in the 33-34 weeks group had no proteinuria while the remaining 50 percent had 1+ proteinuria. Eighty (40 percent) of the babies in 35-36 weeks group had no proteinuria while the remaining 60 percent had 1+ proteinuria. All the 20 babies in the =37 weeks group had 1+ proteinuria (Table III). Of the 60 preterm babies, there was proteinuria ranging from 1+ to 2+ in 42 (70 percent). Forty (66.7 percent) of the 60 preterm babies had proteinuria of 1+. Only 2 (4.8 percent) of the 42 preterm babies with proteinuria had proteinuria of 2+. Considering all the 80 newborn babies together, 62 (77.5 percent) had proteinuria and only 2 (3.2 percent) of these 62 had proteinuria of 2+ (Table III)

Table II

Anthropometric Indices in 80 Neonates

Indices	Gestational Age (weeks) ≤32 (n=20)	33-34 (n=20)	35-36 (n=20)	≤37 (n=20)
Weight (Kg)				
Range	0.95-1.55	1.50-2.30	1.60-2.65	2.55-4.40
Mean	1.27	1.83	2.09	3.14
SD	0.20	0.24	0.21	0.43
Length (cm)				
Range	34.00-41.00	40.00-48.00	42.00-49.00	45.00-53.00
Mean	38.85	43.45	44.70	49.65
SD	2.45	2.52	1.87	1.97
OFC (cm)				
Range	24.00-31.00	29.00-34.00	34.00-35.00	31.00-39.00
Mean	27.80	31.15	32.50	34.40
SD	2.00	1.37	1.34	1.69
Surface Area (m^2)				
Range	0.09-0.13	0.12-0.17	0.14-0.17	0.18-0.24
Mean	0.111	0.145	0.158	0.200
SD	0.012	0.015	0.008	0.018

OFC = Occipito-frontal circumference
SD = Standard deviation

The urine pH in the =32 weeks group, ranged from 6.0 – 8.0 with a mean of 6.9 (SD 0.7) while the range in the 33–34 weeks group was also 6.0 – 8.0 with a mean of 7.0 (SD 0.4). The range of value in the 35-36 weeks group was 6.0 – 7.0 (mean 6.0; SD 0.3) and the range in =37 weeks group was 5.0 – 6.0 (mean 5.7; SD 0.5) (Table IV). The range of urinary pH among the 60 preterm babies was 6.0 – 8.0 (mean 6.7; SD 0.6) while the range in the 20 term babies was 5.0 – 6.0 (mean, 5.7; SD 0.5). There was a significant difference between the mean values of preterm and term babies, (Kruskal Wallis H = 47.00 P<0.001). There was also a negative correlation between the urinary pH and the gestational age (Spearman's rank correlation coefficient = -0.69 P=0.001)(Table V). Furthermore, the pH in 34 (56.7 percent) of the 60 preterm babies was between 7and 8; the rest had a pH of 6, while none had pH below 6. By contrast, seven (35 percent) of the 20 term babies had pH of 5 and the remaining 65 percent had pH of 6 (Table V).

Discussion

Tausch was apparently the first worker to carry out urinalysis in the newborn in 1936[2]

Table III

Urinary Protein according to Gestational Age Groups

Urinary Protein	Gestational Age (weeks)				
	≤32 n=20	33-34 n=20	34-35 n=20	≤37 n=20	Total n=80
Negative	-	10(50)	8(40)	-	18 (22.5)
+ 0.3g/l	18(90)	10(50)	12(60)	20(100)	60 (75.0)
++ 1.0g/l	2(10)	-	-	-	2 (2.5)
+++ 5.0g/l	-	-	-	-	-
Total	20(100)	20(100)	20(100)	20(100)	80 (100)

Figures in parentheses represent percentages.

Table IV

Urinary pH according to Gestational Age

Urinary pH	Gestational Age (weeks)			
	≤32 (n=20)	33-34 (n=20)	35-36 (n=20)	≤37 (n=20)
Range	6.0-8.0	6.0-8.0	6.0-7.0	5.0-6.0
Standard Deviation	0.7	0.4	0.3	0.5
Mean	6.9	7.0	6.1	5.7

Table V

Urinary pH in Preterm and Term Babies

pH	*Preterm (n=60)*	*Term (n=20)*
5	-	7 (35)
6	26(43)	13(65)
7	28(46)	-
8	6(11)	-
Range	6.0-8.0	5.0-6.0
SD*	0.6	0.5
Mean*	6.7	5.7

Figures in parentheses represent percentages
*Kruskal Wallis H = 47.000; P=0.000
*Spearman's rank correlation coefficient = -0.69; P=0.001

when he examined catheterised urine specimens obtained immediately after birth. He used acetic acid and heat to assess the presence or absence of proteinuria, and reported proteinuria in 14.2 percent. Other workers[2] have since, reported proteinuria in up to 100 percent of normal newborn infants between the ages of four days and two weeks. Rhodes *et al* [2] found proteinuria in 21 percent of newborn infants comprising preterm and term infants. It is noteworthy that these studies were carried out in temperate areas and involved mainly Caucasians. This makes the current study unique being, as far as we are aware, the first to involve Nigerian newborns in a tropical environment. The finding of proteinuria in 77.5 percent of the newborns studied, is in close agreement with that of others,[2] but higher than that reported by Rhodes *et al*.[2] This may be because some of the subjects in the study by Rhodes *et al* [2] were older than 72 hours of age by which time, proteinuria might have subsided. From the findings in this study, it is safe to conclude that proteinuria exceeding 2+ in the first 72 hours of life, requires further investigations to rule out a renal pathology since only 2.5 percent of the 80 newborn infants had proteinuria of 2+ while 75 percent had 1+ proteinuria but none had proteinuria of 2+. The absence of glycosuria in the present study was not surprising as clinically stable neonates should not normally have glycosuria.[2,3] However, this is at variance with the findings of some workers who observed glycosuria in as high as 24 percent of urine samples examined.[2] The absence of glycosuria in this study may be because the renal threshold was not exceeded.

An inverse relationship between the urine pH and the gestational age demonstrated in this study has earlier been observed by Edelman *et al*.[4] This is related to the fact that the newborn infant generally has low capacity to reabsorb bicarbonate and excrete titratable acids,[4] a phenomenon that is more pronounced in preterm than term infants. Urine pH of between 7 and 8 found in 55 percent of preterm babies in the present study is also similar to the finding by Stonestreet *et al*[5] that urine pH of preterm babies is commonly above 6. Thirty five percent of term babies in this study had a urine pH of 5, a feat that is usually achieved around the second week in the preterm babies.[6] It is concluded from this study that mild proteinuria can occur in newborn infants in the early neonatal period; glycosuria is rare in normal newborns in the early neonatal period and preterm babies produce urine whose pH ranged from 6 to 8, while term babies produce urine with pH ranging between 5 and 6 during the same period.

References

1. Arant BS. Developmental patterns of renal functional maturation compared in human neonate. *J Pediatr* 1978; **92**: 705-12.
2. Rhodes PG, Hammel CL, Berman LB. Urinary constituents of the newborn infant. *J Pediatr* 1962; **60**: 18-23.
3. Brodehl J, Francken A, Gellisen K. Maximal tubular reabsorption of glucose in infants and children. *Acta Pediatr Scand* 1972; **61**: 413-6.
4. Edelman CM Jr, Rodriguez-Soriano J, Boichi H. Bicarbonate reabsorption and hydrogen ion excretion in normal infants. *J Clin Invest* 1967; **46**: 1309-17.
5. Stonestreet BS, Rubin L, Pollak A. Renal functions of low birthweight infants with hyperglycaemia and glucosuria produced by glucose infusion. *Pediatrics* 1980; **66**: 561-7.
6. Jones DP, Chesney RW. Development of tubular function. In: Clinics in Perinatology. Bailie MD (ed) Philadelphia, WB Sanders Co (Publ) 1992; **19** :33-57.