RENAL FUNCTION IN SFD AND AFD PRETERM BABIES

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ABSTRACT

Maturation of neonatal glomerular function as evidenced by serum creatinine and creatinine clearance was assessed in 15 preterm small for dates infants (Group I) and compared with values obtained in 15 preterm appropriate for date babies (Group II), on 3rd, 7th and 14th postnatal days. The mean gestational ages were 34.2 and 32.5 weeks and birth weights 1436±302g and 1752±422 g, respectively. The mean serum creatinine values in Group I were 1.40±0.28, 1.18±0.22 and 0.92±0.11 mg/dl and for Group II, 1.22±0.22, 1.01±0.24 and 0.82±0.17 mg/dl on days 3, 7 and 14, respectively. Glomerular filtration rates as evidenced by creatinine clearance were 16.08±3.53, 21.25±4.79 and 36.96±6.44 ml/min/1.73 m^2 for Group I as compared to 21.38±6.65, 35.96±11.47 and 57.61±21.61 ml/min/1.73 m^2 for Group II on these days, showing statistically significant ($p<0.001$) increase in renal function in both the groups from days 3 to 14. Even though the serum creatinine values in the two groups were comparable at identical postnatal ages,creatinine clearance was shown to be statistically less ($p<0.05$ on day 3, $p<0.001$ on day 7 and $p<0.01$ on day 14, respectively) in Group I as compared to Group II, thereby implying slower renal maturation in small for dates preterm babies.

Key words: *Preterm, Small for date, Renal function, Creatinine clearance.*

With the advent of neonatal intensive care and the increase in management rate of preterm infants, fluid and electrolyte management and use of renotoxic antibiotics have become common place. The importance of assessing the maturity of kidney function in this setting is only too evident. Even though a number of studies concerning renal function in the term infant are currently available(1-3), similar data on preterm babies is scanty. Though a few cross-sectional renal function studies on neonates of differing gestational ages, birth weights and postnatal ages have been carried out, there has been only one publication on the longitudinal assessment of preterm renal function in the literature. We present here one such study where renal functions has been longitudinally assessed in preterm babies. We have also tried to evaluate the effect of intrauterine growth retardation on the renal function of preterm babies.

Material and Methods

Thirty preterm babies, born in the Nehru Hospital of Postgraduate Institute of Medical Education and Research, Chandigarh formed the study population. Fifteen of these babies were classified as small for dates on the basis of their weights being below the 10th centile of the intrauterine growth curve(4) and were designated Group I (mean birth weight 1436±302 g and mean gestation 34.2

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weeks). Another fifteen babies (mean birth weight 1754±422 g and mean gestation 32.5 wks) forming Group II were appropriate for dates. The gestational age was calculated from the last menstrual period and confirmed by clinical examination of the baby. The preterm infants forming the study population were free from illness and were on oral feeds.

Accurate timed urine collection of 6-8 hours duration were obtained from each infant by means of an external collecting device. Venous blood samples were taken for serum creatinine measurement. The baby weights were taken on an accurate electronic weighing scale and the lengths measured by an infantometer. Surface area was calculated with the Wests nomogram and the serum and urinary creatinine were estimated by the method of Giorgio(5). The measurements were repeated on the 3rd, 7th and 14th postnatal days. Glomerular filtration rate as expressed by endogenous timed creatinine clearance was calculated as per Wests nomogram:

$$Ccr = \frac{U\,V}{P} \times BSA \times 1.73.$$

Where Ccr = Creatinine clearance; U = Urinary creatinine (mg/dl); V = Volume of urine (ml/min); P = Plasma creatinine (mg/dl); BSA = Body surface area (m^2); and 1.73 = Standard adult body surface area.

Statistical analysis was done using the Student's 't' test and the paired 't' test.

Results

Serum creatinine values in the small for date babies (Group I) were 1.40±0.28 mg/dl on day 3, 1.18±22 mg/dl on day 7, and 0.92±0.11 mg/dl on day 14, respectively. In the appropriate for dates (Group II), serum creatinine was 1.22±0.22, 1.01±0.243 and 0.82±0.17 mg/dl on days 3, 7 and 14 respectively.

Statistical analysis revealed that the fall in serum creatinine values in Group I babies from day 3 to 7, 7 to 14 and from day 3 to 14 was highly significant ($p<0.001$). In Group II babies, the fall of serum creatinine from day 3 to 7 and 3 to 14 was highly significant ($p<0.01$). The difference in creatinine values on days 3, 7, 14 between the two groups were not significant ($p>0.05$) (*Table I*).

Creatinine clearance (Ccr)

In Group I babies, the values for Ccr on days 3, 7 and 14 were 16.08±3.53, 21.25±14.75 and 36.96±6.44 ml/min/1.73 m^2, respectively while the values for Group

TABLE I–*Serum Creatinine Levels in SFD and AFD Babies*

Day	SFD	AFD	p value
3	1.40±0.28	1.22±0.22	NS
7	1.18±0.22	1.01±0.24	NS
14	0.92±0.11	0.82±0.17	NS

In SFD day 3 *vs* 7 and 7 *vs* 14 $p<0.001$.

In AFD day 3 *vs* 7 $p<0.001$;
day 7 *vs* 14 $p<0.01$.

II babies were 21.38±6.65, 35.96±11.47 and 57.61±21.61 ml/min/1.73 m^2, respectively. Analysis of data revealed a significant difference in the rates of creatinine clearance between the two groups on all three occasions ($p < 0.05$ on day 3, $p < 0.001$ on day 7 and $p < 0.01$ on day 14). Significant differences in creatinine clearance were observed within each group on comparing the Ccr on day 3 with day 7, with day 14 and day 3 with day 14 (*Table II*).

Discussion

The renal functions in preterm babies are compromised as compared to adult standards. However, studies on neonates tend to show that renal functional maturation is gestational age dependent rather than birth weight dependent(6-9). Allen and Zemen(10,11) have shown that the kidneys of progeny of malnourished rats were functionally and morphologically immature when compared to progeny of well nourished rats at identical gestational ages. The implication is that infants who were small for dates may have subnormal renal functions when compared to appropriate sized babies of comparable gestational ages. We have intended to test this hypothesis.

Serum creatinine values in our study were comparable at identical postnatal ages between the two groups. However, within each group, there was a statistically significant fall through days 3 to 14. Absolute values observed in the present study compare well with reported values in the literature(1,3). The sequential changes in serum creatinine cannot be compared for want of a similar study. Our values, however, are higher than the values observed by Guignard and John(12). Serum creatinine values are known to stabilize late in the low birth weight infant(13) and are affected by maternal creatinine, ongoing creatinine production, rate of creatinine excretion, post conceptional age, hemoconcentration or liberal fluid therapy(14,15).

In the present series, glomerular filtration rates as evidenced by creatinine clearance rose from a mean value of 16.08 to 36.96 ml/min/1.73 m^2 from day 3 to 14 in preterm SFD babies while the rise was from 21.38 to 57.61 ml/min/1.73 m^2 in preterm AFD infants. There was a steady increase in GFR as the postnatal age advanced, though the difference in GFR in SFD and AFD babies persisted till 2 weeks age. The changes in GFR in these babies is consistent with most other reports on the subject(3,16-24).

Reddy *et al.*(23) in their group of preterm babies showed an increase in GFR as

TABLE II—*Creatinine Clearance in SFD and AFD*

Day	SFD	AFD	p value
3	16.08±3.53	21.38 ± 6.65	0.05
7	21.25±4.79	35.96 ±11.47	0.001
14	36.96±6.44	57.61 ±21.61	0.001

In SFD day 3 *vs* 7, 7 *vs* 14 $p < 0.001$.

In AFD day 3 *vs* 7, 7 *vs* 14 $p < 0.001$.

postnatal age advances, but their absolute values for GFR were lower and the rate of glomerular maturation slower. However, this was a cross-sectional study and the differences may also be explained on the basis of a different technique of creatinine estimation used in that study.

Walia *et al.*(7) estimated the creatinine clearance in 18 preterm babies at 24-48 hours of age. Although the values for SFD infants were comparable to values obtained in the present study, they found no difference between SFD and AFD babies. This is understandable in that at the age at which the study was done, the creatinine clearane values of the infant would be a reflection of the mothers serum creatinine levels(6,13). Moreover, the gestational age and birth weights of these babies were also not comparable to our study population. Both experimental and human experience does indicate that GFR is related to the amount of extracellular volume(8,16) and hence GFR when, there is physiologically increased extracellular volume cannot be compared with GFR at a period when the physiologically expanded volume has already been depleted.

In the present study we observed a significant difference in the creatinine clearance rates between the two groups, the values for the SFD group being consistently lower at all postnatal ages. This is consistent with the results of animal experiments(10,11) which show reduced morphological and functional capacity of neonatal rat kidneys, secondary to intra-uterine growth retardation. At birth full term and preterm babies have been shown to have approximately the same GFR (t GFR)/ body surface area(25) and the body surface area being smaller in SGA infants when compared to AGA infants the GFR is also likely to be less. Further, Sutphen(15) has shown that creatinine output correlated best with birth weight.

In the light of this interesting finding of a persistently low GFR in preterm SFD neonates *vis-a-vis* AFD preterm babies, more exhaustive studies at varying gestational ages looking into complete renal functions including tubular functions need to be carried out, especially in view of its implications regarding fluid, electrolyte and antibiotic therapy.

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