EDITORIAL

Assessment of Neonatal Renal Function – A Clinical dilemma

At birth, the kidney must assume primary responsibility for the maintenance of fluid and electrolyte homeostasis and the excretion of many toxic substances. Even in premature infants, the kidney generally responds appropriately to the demands of the extrauterine life. At birth, overall glomerular and tubular function is deficient in absolute as well as relative terms (corrected for 1.73 m^2 body surface area) in comparison with late childhood[1].

The determination of renal function in neonates is not easy due to difficulty to obtain timed urine specimens which is often inaccurate[2]. Besides some methods used for measuring renal function in older children and adult have been proven invalid in neonates. It is clear that the glomerular filtration rate of newborn is much lower than that of adults and is related to conceptional (gestational and postnatal) age. The glomerular filtration rate in case of term infants increases from an average of 5 ml/min to 40 ml/min/ 1.73 m^2 in the first week of life to 10 ml/min or 65 ml/min/1.73 m^2 by 1 to 2 months of age. Before 34 weeks of gestational age absolute glomerular filtration rate is relatively constant at 0.5 to 1 ml/min. The glomerular filtration rate accelerates after 34 weeks of gestational age and can increase 3 to 5 times within a one week period. But the rate of increase in glomerular filtration rate is less in preterm than term infants (1 ml/min/ 1.73 m^2 vs 1.5 ml/min/ 1.73 m^2/day)[3]. The significance of 34 weeks gestational age is not clear till now, but it is assumed to be correlated with the maturity of nephrogenesis in the human kidney.

Evaluation of plasma creatinine concentration is the most clinically useful method of assessment of glomerular filtration rate (GFR). It can be used to calculate an approximate glomerular filtration rate in the first year of life according to the following formula GFR = KL/Pcr, where GFR is expressed as milliliters per minute per 1.73 m^2, K= 0.45 for term infants 0.33 for premature infants, L= body length in centimeter and Pcr= Plasma Creatinine concentration in milligrams per deciliters[4,5]. Plasma creatinine concentration at birth is equal to the maternal plasma creatinine concentration regardless of gestational age or renal function and can increase in the first day or two of life. In term infants plasma creatinine concentration decreases to an average of 0.4 mg/dL by ten days of age. This level is maintained throughout the next 1 to 2 years of life. It then gradually increases at the rate of 0.02 mg/ year as muscle mass increases without further change in GFR. The plasma creatinine concentration in preterm infants may not change significantly until about 34 weeks gestational age. Subsequently it will normally decline but may not reach equivalent to term infant values until 1 to 3 months after birth[3]. In any infant, a significant increase in plasma concentration after the first day or two of life is abnormal. An increase of more than 0.3 to 0.5 mg/dL/day indicates significant renal insufficiency. At birth healthy premature infants, less than 30 weeks of gestational age continue to excrete large amounts of sodium (average fractional excretion 5%) and are at risk of a negative balance for sodium. In contrast, term newborns consistently have fractional excretions of sodium 1% or less and maintain positive sodium balance over a wide range of sodium intake. Both term and preterm infants are unable to excrete an acute sodium load as well as older children.

Measurement of renal sodium handling is helpful for evaluating oliguria. A fractional excretion of sodium less than 2% is consistent with a normal renal response to hypoperfusion. Immediate attention to the underlying cause of diminished renal blood flow should restore normal urine flow. For infants older than 32 weeks gestational age, oliguria and a fractional excretion of sodium greater than 3% indicate intrinsic renal damage[3]. In this situation, oliguria usually can not be readily reversed and renal failure ensures.

Radionuclide renal scanning provides an excellent method of assessing renal function and compliments the anatomic information obtained from ultrasonography. Proper interpretation of renal function tests in newborn infants requires knowledge of conceptual age. A plasma creatinine concentration of1.2 mg/dL, Serum bicarbonate concentration of 16 mmol/L and a fractional excretion of sodium 5% is normal in a 2-week-old infant born at 28 weeks' gestational age but markedly abnormal in a 2-week-old baby born at term.

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