

ACUTE RENAL FAILURE IN THE NEWBORNS HOSPITALIZED AT THE INTENSIVE CARE UNIT, UNIVERSITY CLINICAL CENTRE TUZLA

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Primljen/Received 27. 01. 2015. god.

Prihvaćen/Accepted 28. 02. 2015. god.

Abstract: Introduction: Reasons for acute renal failure in hospitalized infants were sepsis, hypovolemia, asphyxia, respiratory distress syndrome, surgical interventions and congenital heart defects.

The aim of this study was to determine the frequency and main etiologies, and early outcome of neonatal acute renal failure.

Materials and Methods: At Intensive Care Unit, Clinical Center Tuzla, from 15. 01. 2013 to 15. 01. 2015 in 21 newborn was diagnosed renal failure, based on the amount of excreted urine and serum creatinine.

Results: The prevalence of renal failure was 6.84%, with a higher incidence of female. 33.3% of infants were term neonates. Oliguria was diagnosed in 71.4% of newborns. Sepsis was the most common predisposing factor for the development of renal failure, associated with high mortality. Other causes of renal failure were perinatal hypoxia, RDS, surgical interventions and congenital heart defects. There was a positive correlation between the gestational age of the newborn and serum creatinine.

Discussion: Early prevention of risk factors with rapid diagnosis and effective treatment, can affect further outcome of acute renal failure in infants.

Key words: acute kidney injury, newborns, intensive care unit.

INTRODUCTION

Acute renal failure (ARF) is a common problem in the hospitalised newborn at Intensive care unit (ICU). It is the rapid decline in the kidney ability of maintaining homeostasis of water and electrolytes, associated with a reduction of the glomerular filtration rate (1). Currently, there is not a uniform definition of ARF in adult and pediatric patients, and ARF is defined in multiple ways, but the majority of definitions of ARF

currently in use involve a change in the serum creatinine level. ARF in term newborns within the first few days of life refers to progressive increment in plasma creatinine by higher than 1,5 mg/dl for at least 24–48 h, if a mother has normal kidney function. Serum creatinine concentration in preterm infants in the first few days of life may not be a reflection of the glomerular filtration rate because creatinine rises during the first 36–96 h and then decreases gradually during the first 2 weeks (1, 2, 3). The plasma creatinine concentration immediately after term delivery declines gradually from 1,1 mg/dl (preterm neonate from 1,3 mg/dl) to 0,4 mg/dl during the first 2 weeks of life (2, 3). In the newborn, renal failure may have a prenatal onset in congenital diseases such as renal dysplasia with or without obstructive uropathy and in genetic diseases such as autosomal recessive polycystic kidney disease. Acute renal failure in the newborn is also commonly acquired in the postnatal period because of hypoxic ischemic injury and toxic insults. Nephrotoxic acute renal failure in newborns is usually associated with aminoglycoside antibiotics and nonsteroidal anti-inflammatory medications used to close a patent ductus arteriosus. Renal artery thrombosis and renal vein thrombosis will result in renal failure if bilateral or if either occurs in a solitary kidney. Cortical necrosis is associated with hypoxic/ischemic insults due to perinatal anoxia, placenta abruption and twin-twin or twin-maternal transfusions with resultant activation of the coagulation cascade (2, 3). Pre-renal injury results from renal hypoperfusion due to true volume contraction from hemorrhage, dehydration due to gastrointestinal losses, salt-wasting renal or adrenal diseases, central or nephrogenic diabetes insipidus, increased insensible losses, as occurs in burns, and in disease states associated with third space losses, such as sepsis, nephrotic syndrome, traumatized tissue, and capillary leak syndrome. Decreased ef-

fective blood volume occurs when the true blood volume is normal or increased but renal perfusion is decreased due to diseases such as congestive heart failure, cardiac tamponade, and hepatorenal syndrome. Whether pre-renal injury is caused by true volume depletion or decreased effective blood volume, correction of the underlying disturbance will return renal function to normal (3, 4, 5). Considering the high incidence rate of ARF (10–26%) in hospitalized newborns and the high mortality rate of this disease (20–50%), it is one of the most important diseases among ICU patients (2, 3, 4, 5). Oliguria was defined as urine output < 1 ml/Kg/hr, so that patient with ARF were subdivided into oliguric and nonoliguric (4, 5). Reduction of urine cannot be the only criterion for ARF (2, 5). Measurement of plasma creatinine level is the simplest and most practical mean for assessment of renal function (5, 6, 7). Treatment of ARF includes conservative therapy, dialysis, and rarely surgery of urinary tract obstruction. Some early outcomes observed in ARF of neonates include death and long-term hospitalization due to various conditions such as convulsion, uremic encephalopathy, and sepsis. The aim of this study was to determine the frequency and main etiologies of ARF, and early outcome of neonatal ARF.

MATERIAL AND METHODS

The analysis included hospitalised 307 newborns at Intensive Care Unit, in the Clinical for children disease of the University Clinical Centre Tuzla in the period between 15. 01. 2013 and 15. 01. 2015. All data of

our patients were acquired based on available medical documentation (illness history and medical charts), physical examination and laboratory findings. ARF was diagnosed in 21 hospitalized newborns, if serum creatinine level was > 1.5 mg/dl. The urine output criteria were incorporated to pRIFLE and named neonatal RIFLE, or nRIFLE (8). Statistical analysis were performed with biomedical application software called "MedCalc for Windows, version 114.4". $P < 0.05$ were considered as statistically significant.

RESULTS

In total, 21 out of hospitalised 307 neonates (6,84%) were diagnosed as ARF. Of 21 ARF newborns, 15 (87,8%) were female and 6 (28,6%) were male, with significant difference ($p = 0,01$). The average age of patients was $8,4 \pm 1,4$ days and the average weight of ARF neonates was 2285 ± 890 g. 14 patients (66,7%) were pre-term neonates. The mean duration of hospitalization for each newborn was $10,2 \pm 3,2$ days. Oliguria was detected in 15 patients (71,4%) and 6 newborns (28,6%), were nonoliguric. The most common causes of ARF in our patients were, in order of prevalence, included sepsis (71,5%), followed by hypoxia secondary to perinatal asphyxia (42,8%), RDS (38%), same such as surgical procedure (38%), and congenital heart disease (23,8%). Death occurred in 18 patients (36,7%), while 63,3% were discharged with normal renal function (Table 1). There was a significant relationship between gestation age, and plasma creatinine level (Table 2).

Table 1. Demographic and clinical data of newborns with acute renal failure

Variable	Kidney failure n = 21 (6,8%)		P value
	Oliguric n = 15 (71,4%)	Nonoliguric n = 6 (28,6%)	
Gestational age			
Preterm	10 (47,6%)	4 (19%)	0,12
Term	2 (9,5%)	5 (23,8)	
Gender			
Female	13 (86,6)	2 (33,3)	0,01
Male	4 (26,6)	2 (33,3)	
Weight (g)			
< 2500	14 (93,3)	4 (66,7)	0,57
> 2500	1 (6,67)	2 (33,3)	
Etiology			
Sepsis	9 (60)	5 (83,3)	0,57
Perinatal asphyxia	8 (53,3)	3 (50)	0,12
RDS	8 (53,3)	3 (50)	0,54
Surgical procedure	6 (90)	2 (33,3)	0,37
Congenital heart disease	3 (20)	1 (16,7)	0,33
Outcome			
Death	14 (93,4)	2 (33,3)	0,88
Discharge	2 (73,4)	3 (50)	

Table 2. Demographic and laboratory data of newborns with acute renal failure

Demographic and laboratory data	OR- odds ratio	Beta	P value
Age	0,17	-6,262	0,617
Gestational age	0,673	-0,513	0,032
Weight	10,365	0,231	0,223
Creatinine	5,471	2,245	0,016

DISCUSSION

In our study 21 of hospitalised 307 neonates (6,84%) were diagnosed as ARF. The incidence of AKI in children appears to be increasing and the etiology of ARF over the past decades has shifted from primary renal disease to multifactorial causes, particularly in hospitalized children (6, 7). Critically ill neonates are at greater risk of having AKI as they are commonly exposed to nephrotoxic medications and have frequent infections, which leads to multiorgan failure (1, 3, 4).

Of our 21 newborns with ARF, 15 (87,8%) were female and 6 (28,6%) were male. In other studies, the boys had a higher prevalence of ARF (9, 10). 66,7% patients were pre-term neonates. Newborn's kidneys are more susceptible to hypoperfusion and have low glomerular filtration rate, high renal vascular resistance, high plasma renin activity, decreased intercorical perfusion, and decreased reabsorption of sodium in the proximal tubules. All these features make newborns more susceptible to injury in the first days of life (11).

The average age of our patients was $8,4 \pm 1,4$ days and the average weight of ARF neonates was 2285 ± 890 g. In Nouri et al., study the average age of the patients was similar like us $8,0 \pm 2,5$ days, while the birth weight was more then 2500 g in ARF group (12).

The mean duration of hospitalization for each newborn was $10,2 \pm 3,2$ days. In other study the mean duration of hospitalisation was shorter according with other comorbidity (12, 13).

The most common causes of ARF in our patients were, in order of prevalence, included sepsis (71,5%), followed by hypoxia secondary to perinatal asphyxia (42,8%), RDS (38%), same such as surgical procedure (38%), and congenital heart disease (23,8%). Sepsis and incidence of ARF were significantly related ($P = 0.03$). Recent studies included only special neonatal populations have shown that postneonatal asphyxia, low birth weight, and after cardiac surgery have significant more ARF in compare with other (6, 7, 11, 12).

In study of Csaicsich at all., the most common causes of renal failure was sepsis and all infants were managed conservatively with corrections of fluids, electrolytes and acidosis, including medication with diure-

tics and dopamine. In the same study infants with low urine output, higher scores for failed organs or low birth weight were significantly more likely to die (6).

Most of neonates with oliguric ARF (65%) had severe perinatal asphyxia while in those with nonoliguric ARF moderate perinatal asphyxia predominated (73%) (13). Serum creatinine values were significantly higher in asphyxiated babies (12, 14). Five minute Apgar $< \text{or} = 6$ had the best sensitivity to predict renal failure in asphyxiated babies (9, 10).

Aggarwal et al. (17) indicated that ARF was developed in 26.0% of newborns from which 15% had RDS. The mortality occurred in 20% of the newborns, which was higher in patients with sepsis, RDS and ones who needed mechanical ventilation (10, 15). ARF after pediatric cardiac and other operations is associated with poor outcomes and is difficult to predict (16).

Children who have ARF as a component of multisystem failure have a much higher mortality rate than children with intrinsic renal disease (7, 14). Recovery from intrinsic renal disease is also highly dependent on the underlying etiology of the ARF. Children who have experienced ARF from any cause are at risk for late development of renal failure long after the initial insult. Such children need life-long monitoring of their renal function, blood pressure, and urinalysis.

CONCLUSION

The most common causes of neonatal ARF are hypovolemia, hypotension and hypoxia. The prevention of ARF is likely to have a larger impact on mortality rates than other measures. Newborns with acute renal failure need life-long monitoring of their renal function, blood pressure, and urinalysis.

Abbreviations

ARF — Acute renal failure

ICU — Intensive care unit

RDS — respiratory distress syndrome

pRIFLE — pediatric Risk, Injury, Failure, Loss, End-Stage Renal Disease

nRIFLE — neonatal Risk, Injury, Failure, Loss, End-Stage Renal Disease

Sažetak

AKUTNA RENALNA INSUFICIJENCIJA KOD NOVOROĐENČADI HOSPITALIZOVANIH NA ODELJENJU INTENZIVNE NEGE UNIVERZITETSKOG KLINIČKOG CENTRA TUZLA

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Uvod: Razlozi akutne bubrežne insuficijencije kod hospitalizovanih novorođenčadi su sepsa, hipovolemija, asfiksija, respiratorni distres sindrom, hiruške intervencije i urođene srčane mane.

Cilj: ove studije je bio utvrditi učestalost i razloge akutne bubrežne insuficijencije novorođenčadi, uz faktore koji su uticali na rani ishod bolesti.

Materijal i metode: U Odeljenju intenzivne terapije i nege, Kliničkog Centra Tuzla, od 15. 01. 2013. do 15. 01. 2015. godine kod 21 novorođenčeta je dijagnostikovana bubrežna insuficijencija, na osnovu količine izlučenog urina i serumskog kreatinina.

Rezultati: Prevalenca bubrežne insuficijencije je bila 6,84%, sa većom učestalošću ženskog pola. 33,3% no-

vorodenčadi su bila terminska deca. Oligurija je dijagnostikovana u 71,4% novorođenčadi. Sepsa je bila najčešći predisponirajući faktor za nastanak bubrežne insuficijencije, udružena sa visokim mortalitetom. Drugi razlozi bubrežne insuficijencije su bili perinatalna hipoksija, respiratorni distres sindrom, hiruške intervencije i urođene srčane mane. Nađena je pozitivna korelacija između gestacijske dobi novorođenčeta i nivoa serumskog kreatinina.

Diskusija: Rana prevencija rizičnih faktora uz brzo dijagnostikovanje i efektivni tretman, može uticati na dalji ishod akutne bubrežne insuficijencije kod novorođenčadi.

ključne reči: akutna bubrežna insuficijencija, novorođenčad, Odeljenje intenzivne terapije i nege.

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