

Acute Renal Failure in Neonates

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ABSTRACT:

BACKGROUND:

Acute renal failure (ARF) is a common problem in admitted neonates in intensive care units. In most patients ARF accompanies with a predisposing factor such as sepsis, heart failure, perinatal asphyxia or prematurity.

OBJECTIVE:

This study was to determine the causes and outcome of ARF in hospitalized newborn

PATIENTS AND METHODS:

In a descriptive cross sectional study we evaluated neonates with ARF who had been hospitalized in Children welfare teaching Hospital from July 2009 to July 2010.

RESULTS:

There were 50 cases diagnosed as ARF in 2500 hospitalized neonates (2%). The male to female ratio in patients with ARF was 3.16:1.

Most of involved patients were term 35(70%).

The prevalence of renal, pre renal and post renal causes of ARF was 29 (58%), 15(30%) and 6(12%) respectively.

The most common predisposing factors for ARF in our study was sepsis 28(56%), genitorenal anomalies 15(30%), perinatal asphyxia 3(6%), drug toxicity in 3(6%)

One patient (2%) had respiratory distress syndrome.

Among admitted neonates with ARF 6(12%) died and it was significantly higher in patients with sepsis ($P < 0.05$).

CONCLUSION:

ARF is a common emergency entity, physicians play a critical role in recognizing early ARF, preventing iatrogenic injury, and reversing the course of ARF.

KEY WORDS: acute renal failure, newborns, predisposing factors

INTRODUCTION:

Acute renal failure (ARF) is defined as an acute deterioration in ability of the kidneys to maintain homeostasis of body fluids, electrolytes and is associated with acute decrease in the rate of glomerular filtration (GFR) that leads to retention of wasted and toxic metabolic end products^(1,2)

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 or acquired in the postnatal period because of hypoxic ischemic injury and toxic insults. A wide variety of predisposing factors associated with the development of ARF in the newborns such as sepsis, respiratory distress syndrome, dehydration and congestive heart failure^(3,4)

The short-term outcome of therapy for ARF in newborns is highly dependent on the underlying etiology of ARF, the condition of other organs, and the facilities for renal replacement therapy. Mortality is more frequent and morbidity is much worse in neonates with multiorgan failure⁽⁵⁾

This study was performed to evaluate the types, frequency of associated contributing conditions, and short-term outcomes of ARF in neonates admitted in this hospital, which is a referral and tertiary care center.

PATIENTS AND METHOD:

This study was conducted in the neonatal care unit of the Children's welfare teaching Hospital in Baghdad. Medical records of admitted neonates diagnosed with ARF between July 2009 and July 2010 were studied. Acute renal failure was defined as a plasma creatinine level higher than 1.5 mg/dL^(1,4) or a blood urea nitrogen (BUN) level higher than (20 mg/dL) on 2 separate occasions at least 12 hours apart, while maternal kidney function was normal⁽⁵⁾

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Oligurea was defined as urinary output less than 1 mL/kg/h. Response to fluid challenge was defined as resolving the oliguria after infusion of up to 3 doses of hypertonic saline solution, 20 mL/ kg, and restoration of creatinine level to less than 1.5 mg/dL. Neonates who had obstruction in the urinary tract system based on imaging studies (ultrasonography or renal scintigraphy) were considered as post renal failure. The remaining patients were considered to have intrinsic kidney failure if they did not respond to fluid challenge.

Sepsis was diagnosed in symptomatic patients on the basis of either a positive blood culture for microorganisms or on clinical grounds in association with a positive sepsis screen ,leucopenia.

The short-term outcome was determined by following the clinical course until discharge from hospital and was categorized into 3 groups of “death,” “discharge with normal kidney function,” and “discharge with diminished kidney function.” Neonates who did not have enough data in their records were excluded.

The data collected for each patient were demographic features, clinical and laboratory findings, short-term outcome, and presence of any associated contributing conditions including

perinatal asphyxia, sepsis, respiratory distress syndrome, dehydration, heart failure, exposure to nephrotoxic drugs (aminoglycosides, and vancomycin), congenital anomalies of the urinary tract system.

Statistical analysis was performed using the statistical package for social sciences for windows (SPSS 12). P. Value < 0.05 considered statistically significant.

All quantitative data were expressed as mean ± standard deviation.

RESULTS:

Of 2500 admitted neonates to Children welfare Teaching Hospital, during the studied period form July 2009 to July 2010, 50 (2.2%) patients were diagnosed with ARF. including 38 (76%) males and 12 (24%) females. Male to female ratio was 3.16:1 .

Most of the patients with ARF were term 35 (70%), 11 (22%) were preterm, and 4 (8%) were post term.

Three patients (6%) developed ARF after admission to the hospital , two patients were treated with aminoglycoside and one patient with vancomycin.

Table 1 demonstrates the age, weight, and laboratory findings of the neonates at admission.

Table 1: Demographic characteristic and renal function tests of hospitalized neonates

	Mean ± SD	minimum	maximum
Age (days)	5.26±6.2	2	28
Gestational Age (Wk)	37.35±3.66	28	42
Weight (gr)	2469±612	1100	4600
Pcr(mg/dl)	3.4±1.5	1.4	7.9
BUN(mg/dl)	67± 42	28	170

Main clinical features on presentation were oliguria in 28(56%), refusal to food in 40 (80%), lethargy in 43 (58%).

The cause of ARF was prerenal failure in 6 patients (12%), intrinsic kidney failure in 29 (58%), and post renal failure in 15(30%).

The frequency of each associated contributing condition is shown in Table 2.

Genitourinary anomalies were diagnosed in 15 (30%) patients, including vesicoureteral reflux in 6(12%); posterior urethral valve in 4(8%), and renal hypoplasia, unilateral renal agenesis; polycystic kidney, multicystic dysplastic kidney, and ureteropelvic junction obstruction, each in 5 patients.

Six neonates(12%) ,2 girl and 4 boys died during

their hospital stay, all neonates were oliguric ,one was a male term neonate with severe asphyxia and the other five neonates were preterm. three patients with sepsis passed into septic shock and multiorgan failure , and one patient with posterior urethral valve died ,one with bilateral renal hypoplasia.

None was offered peritoneal dialysis. Twenty nine (58%) were discharged with normal kidney function, patients treated with nephrotoxic drugs , their renal function returned to normal after discontinuing, modifying the dose, or changing to a nonnephrotoxic antibiotic.

Fifteen patients (30%) were discharged with diminished kidney function , and they were cases of genitourinary anomalies or sepsis.

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Dead cases were more frequent in Females (2 of 12; 16.6%) than boys (4 of 38; 10.5%) (P = .001).

Sepsis was significantly more frequent in the patients who died than in those who survived (P = .01).

Table 2: Predisposing factors for ARF

predisposing factors	No.	Percent%
Genitorenal anomalies	15	30
sepsis	28	56
Asphyxia	3	6
Nephrotoxic drug administration	3	6
respiratory distress syndrome	1	2

DISCUSSION:

A wide variety of malformations or prenatal, perinatal and postnatal events may cause ARF. ^(1, 2, 6)

In most of studies Asphyxia and sepsis were the commonest predisposing factors for ARF. ^(3, 4, 6, 7, 8). In this study sepsis was the commonest predisposing factors for ARF

In the studies done by Airede A. et al. ,Kandoth Pw. et al. and Bourquia A .etal. ^(6,9,10) the prevalence of ARF in boys were more than girls and it was same in our patients.

It assumes that predisposing factors of ARF such as sepsis are more common in boys than girls.

Pre renal cause for ARF was found in 6 (12%) patients in this study, most of these cases presented with symptoms of feeding problems (refusal to feed, vomiting and diarrhea) which was the main cause behind their dehydration and hypovolemia.

Delayed management of associated symptoms may cause aggregation of renal injury.

Intrinsic renal failure was found in 29(58%) of cases in this study and the progression of intrinsic renal failure is multifactorial and involves vascular (hemodynamic), nephronal or cellular (metabolic) factors. Decreased renal blood flow may result from multiple mechanisms such as hypotension, heart failure and vasoconstriction. ^(6, 11,12)

ARF can be nonoliguric, thus, if plasma creatinine is not monitored daily in severely asphyxiated neonate, renal failure will be easily missed. Oligoanuria in these infants may result from pre renal failure mediated by endothelin, intrinsic renal failure (ATN) or syndrome of inappropriate secretion of ADH (SIADH).

In the study done by J. B. Gouyonand and J. P. Guignard ⁽¹³⁾ they found that the leading causes for renal insufficiency in neonates are perinatal anoxia-ischemia and sepsis, which are usually associated with hypovolemia, hypoxemia, and hypotension in the newborn infant.

In this study 3(6%) newborn infants were moderately to severely asphyxiate and their ARF was non oliguric in two asphyxiated neonates.

Drugs were the second most common cause of renal failure, accounted for 14% in the report done in department of pediatrics, King Hussein Medical Center, and Amman, Jordan. ⁽¹⁴⁾

In this study three patients (6%) developed ARF after admission to the hospital, two patients were treated with amino glycoside; and one patient treated with vancomycin, all patients survived and showed dramatic improvement after discontinuing, modifying the dose, or changing to a nonnephrotoxic antibiotic.

There were 31 (62%) oliguric renal failures in this study which is same as other reports. ^{3, 12}, but less than the pakistani report which had high prevalence of asphyxia in their patients that predispose to nonoliguric ARF. ⁽⁵⁾

Short term prognosis for neonatal ARF depends on general condition and status of all major organ systems of infant. In some studies, the mortality rate in oliguric ARF due to acquired conditions such as asphyxia and sepsis was 60% and there are reports of higher mortality rate in the presence of heart disease. The prognosis for non oliguric renal failure or for prerenal failure is excellent, unless major arrhythmia secondary to hyperkalemia or multiorgan failure develops. ^(12, 6)

In this study, mortality in hospitalized neonates with ARF was 6cases (12%) and the most important risk factors for mortality were sepsis.all patients were having oliguric renal failure. In most cases of acute renal failure in neonates, mortality was related to the underlying disease rather than the renal failure.

In the study done by Doronjski A, Stojanović V, Spasojević S, et al. on Acute renal failure in premature neonates they found that Hemodynamic stress is the leading cause of acute renal failure

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(ARF) in premature neonates and incidence of ARF in this population is between 8 and 24%.⁽¹⁵⁾ In this study only one term neonate died all others were preterm. it is mentioned that

CONCLUSION:

In high risk newborn infants with positive history of predisposing factors for ARF, correction of any abnormality of oxygenation, ventilation, cardiac output, blood pressure and early treatment of sepsis is needed for prevention and effective management of ARF.

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