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Khawlah Alwan Salman
Department of Pediatrics, Nephrology Unit, Babylon Teaching Hospital for Maternity and Children, Iraq

Mohammed Hamzah Merzah
Department of Pediatrics Babylon Teaching Hospital for Maternity and Children, Iraq

Ameer Mohammed Khudhair
Department of Pediatrics Babylon Teaching Hospital for Maternity and Children, Iraq

Corresponding Author:
Khawlah Alwan Salman
Department of Pediatrics, Nephrology Unit, Babylon Teaching Hospital for Maternity and Children, Iraq

Acute kidney injury in neonatal care unite of Babylon teaching hospital for maternity and children

Khawlah Alwan Salman, Mohammed Hamzah Merzah and Ameer Mohammed Khudhair

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Abstract
Background: Asphyxia, respiratory distress syndrome (RDS), and urogenital abnormalities are major causes of infant acute kidney damage (AKI) in the neonatal critical care unit. This research examines the incidence and risk factors of acute kidney injury (AKI) in newborns admitted to the NICU from September 2022 to March 2023.
Method: A prospective study was conducted to evaluate neonates with AKI who had been hospitalised in Babylon teaching hospital for maternity and children. Information such as gender, gestational age, body weight, age at presentation, predisposing factors, duration of hospitalisation, and type of treatment, whether conservative or requiring renal replacement therapy such as peritoneal dialysis, were all included in the study.
Results: The male-to-female ratio among ARF patients was 1.68:1. Renal, pre-renal, and post-renal causes of ARF were 37 (49%), 23 (31%), and 15 (20%), respectively, in term 58 (77%) and preterm 14 (19%) and postterm 3 (4%). Sepsis 42 (56%), genitourinary abnormalities 15 (20%), perinatal asphyxia 5 (6.67%), RDS 3 (4%), and other causes 10 (13.33%) were the most prevalent ARF predisposing variables. 44 (58.67%) of hospitalised neonates with ARF discharged well, 17 (22.67%) with impaired renal function, 10 (13.33%) died, and 4 (5.33%) were sent to other hospitals. Sepsis was substantially greater.
Conclusion: Neonatal acute renal insufficiency is severe. Our hospital's newborn acute renal failure frequency, contributory factors, and short-term prognosis are similar to previous research, however intrinsic kidney failure is the most prevalent kind. Sepsis is the leading cause of neonatal acute renal failure and mortality.

Keywords: Acute, kidney, injury, neonatal, care, unite, Babylon, teaching

Introduction

Acute Kidney Injury (AKI) is an intricate pathology that denotes a rapid decline in kidney function, often triggered by a broad spectrum of conditions either targeting the kidney directly or indirectly. Spanning across all age groups, it has been observed with heightened incidence among neonates, especially those admitted to neonatal intensive care units (NICUs) and predominantly in preterm infants [1, 2]. Over the past decade, concerted efforts have been channeled to better comprehend and categorize the syndrome erstwhile termed as "acute renal failure" (ARF), culminating in the broader nomenclature "acute kidney injury" (AKI). In a pursuit for a universally accepted AKI classification, the Acute Dialysis Quality Initiative (ADQI) in 2004 propounded the RIFLE classification - an acronym for “risk, injury, failure, loss, end-stage kidney disease” [3]. Foundational to RIFLE's criteria was the acute and reversible surge in serum creatinine (SCr) levels, which may or may not coincide with alterations in urine output (UO), specifically oliguria/anuria. Such classifications underwent further modifications to suit pediatric populations, resulting in the pediatric RIFLE criteria (pRIFLE). Yet, this posed challenges when applied to neonates, largely due to unique neonatal characteristics like elevated total body water, nascent tubular cells, and influence of maternal SCr. This necessitated the development of a neonatal-centric classification, termed the nRIFLE [4]. While assessing the incidence, it's pertinent to acknowledge that pinpointing the exact frequency of neonatal ARF remains arduous. Studies indicate a range of 8% to 24% incidence among neonates in NICUs. However, these figures could underestimate the reality, especially when considering nonoliguric neonatal ARF, which is prevalent in critically ill neonates [5, 6].

A myriad of risk factors is associated with neonatal AKI, from very low birth weight to drug administration, and encompassing clinical conditions like respiratory distress syndrome and sepsis [7-10]. Etiologically, neonatal AKI can be ascribed to pre-renal, renal, and post-renal causes, with prerenal failure as the predominant form. This susceptibility stems from the unique physiological attributes of neonatal kidneys, rendering them more vulnerable to conditions like acute tubular necrosis or cortical necrosis [11, 12]. The aim of this work is to study the incidence and risk factors of acute kidney injury (AKI) in neonates admitted to the neonatal intensive care unit (NICU).

Materials and Methods

From September 2022 to March 2023, a prospective investigation was conducted in the neonatal care unit of the Babylon teaching hospital for maternity and children. According to inclusion and exclusion criteria, 87 neonates are identified as having AKI. (12 cases were excluded from the analysis, while 75 were included). The exclusion criteria were as follows: (1) neonates who expired within 24 hours of admission, and (2) neonates whose mothers had a history of kidney failure. (3) Newborns with fatal congenital defects. (4) Neonates whose medical records lacked sufficient information or who were discharged due to family responsibilities were excluded from the study. Age, sex, weight at admission, gestational age, mode of delivery, as well as predisposing factors such as perinatal asphyxia, sepsis, respiratory distress syndrome, dehydration due to feeding problems, heart failure, nephrotoxic drug administration and its duration, urologic anomalies, history of surgical operation and reason for surgery, and mechanical ventilation and its duration, were studied for admitted neonates with ARF. All of the newborns were thoroughly examined. Moreover, the following investigations were conducted on each case: 1. Laboratory tests: serum creatinine, blood urea nitrogen, complete blood count, C-reactive protein, arterial blood gases, urine culture, and blood culture. Radiological evaluation when necessary (renal imaging investigations). AKI was defined as a plasma creatinine level greater than 1.5 mg/dl [11] or a blood urea level greater than 20mg/dl on 2 separate occasions at least 12 hours apart while the maternal renal function was normal [12]. Response to fluid challenge was defined as resolution of oliguria after infusion of up to 3 doses of isotonic saline solution (20 mL/kg) and restoration of creatinine level to less than 1.5 mg/dl; patients were considered to have intrinsic kidney failure if they did not respond to fluid challenge; neonates with obstruction in the urinary tract system based on imaging studies (ultrasonography, which was performed on all patients) were considered to have post renal failure. Symptomatic patients were diagnosed with sepsis based on a positive blood culture/urine culture for microorganisms or on clinical grounds in conjunction with a positive sepsis screen, such as a positive C reactive protein. Chest X-ray for RDS diagnosis. Included in the study was the type of treatment, whether only conservative (including fluid therapy for acidosis and electrolyte abnormalities) or requiring renal replacement therapy such as peritoneal dialysis (PD). Indications for initiating renal replacement therapy consist of severe metabolic acidosis, electrolyte abnormalities (such as hyperkalemia), fluid excess, and symptomatic uremia. The neonate's prognosis was classified as "death," "discharge with normal kidney function," or "discharge with decreased kidney function and referral to *another hospital." There was statistical analysis performed.* P. Value less than or equal to 0.05 is statistically significant. All quantitative information was presented as the mean standard deviation.

Results

During the study period from September 2022 to March 2023, 87 case diagnose as ARF 12 cases were excluded from study and 75 cases were including in the study. 47 neonates of them (63%) were male and 28 neonates (37%) were female with male to female ratio 1.68:1 as shown in figure (1)

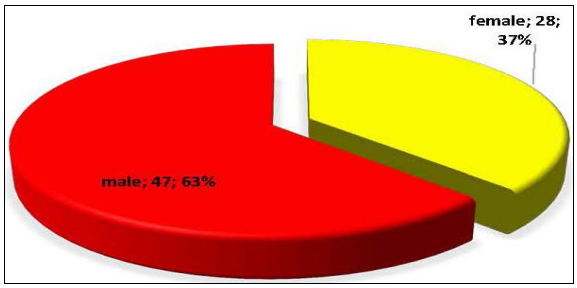

Fig 1: Sex distribution of neonates with acute renal failure

Regarding the age at presentation it ranges from (1-28) days, mean 13.99 days, in the first week (1-7 days) 19 neonate which constitute about 26%, in the second week (8-14 days) 21 neonate forming about 27%, and 35 neonates their age from (15-28 days) about 47% as in the figure (2) below.

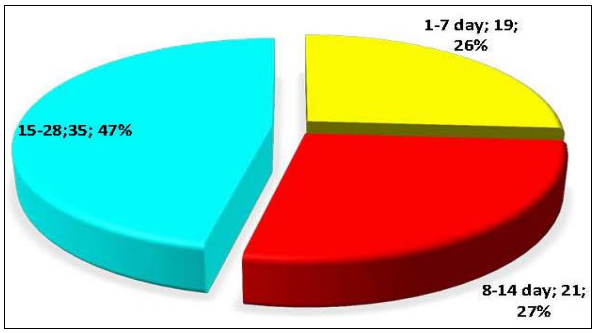

Fig 2: Regarding the age at presentation it ranges

Majority of cases with ARF were term 58 neonate (77%) 36 of them were male and 22 of them female, 14 (19%) were preterm while the post term 3(4%) as shown in figure (3) below.

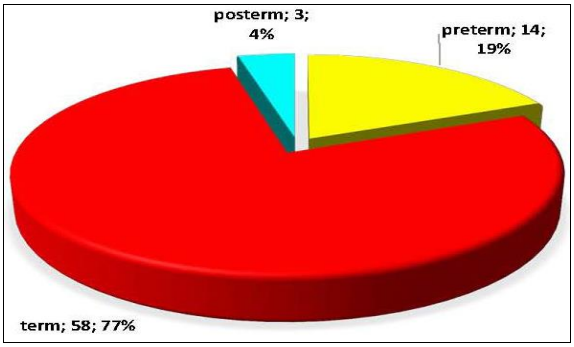

Fig 3: Gestational age distribution of neonates with acute renal failure

Table 1: Laboratory findings of the neonates with acute renal failure

Parameters	Minimum	Maximum	Mean	Standard deviation	95% CI
Hemoglobin cone. (g/dI)	7	18	14.24	2.73	13.73-14.99
White blood cells count (*10^3cell/ nun^3)	3.0	60.0	13.39	10.95	10.74-16.16
Platelets count (*10^3cell/nun^3)	70.0	650.0	233.11	136.04	200.04-266.91
Blood urea (mg/di)	35	320	124.07	73.78	105.6-141.33
Serum creatinine (mg/dl)	1.5	4.9	2.32	1.23	2.03-2.63

The minimum duration of hospitalization was 2 days and maximum 23 days with mean 8.84 while regarding the weight of neonate it range from 950 gm. to 5200 gm. with mean 3318 gm. as shown in table (2).

Table 2: Demographic Features of the neonates with acute renal failure

Parameters	Minimum	Maximum	Mean	Standard deviation
Age at presentation (Day)	1	28	13.99	8.51
Duration of hospitalization (Day)	2	23	8.84	4.58
Weight (gm)	950	5200	3318.0	849.19

Table 3: Comparison of laboratory findings for sepsis in the neonates with acute renal failure by Chi square test

Parameters	Positive		Negative		p-value
	No.	%	No.	%	
C reactive protein	42	56	33	44	<0.001
Blood culture	7	9.33	68	90.67	
Urine culture	20	26.67	55	73.33	

From this study the major predisposing factor to ARF was sepsis which seen in 42 neonate (56%) (25 one of them were male and 17 were female, 35 of them term, 5 preterm and 2 posterm), genitourinary anomalies found in 15 neonate (20%) including vesicoureteral reflux in (5) neonate, posterior urethral valve in (4) neonate, one neonate with renal hypoplasia, one unilateral renal agenesis, and ureter pelvic junction obstruction found in 5 neonate all of them diagnosed by imaging study. While 10 neonates (13.33%) had other causes predisposing them to ARF 5 dehydration due to diarrhea and vomiting 3 developed renal failure after surgery two had congenital heart disease with poor oral intake. shown in figure (4) as below

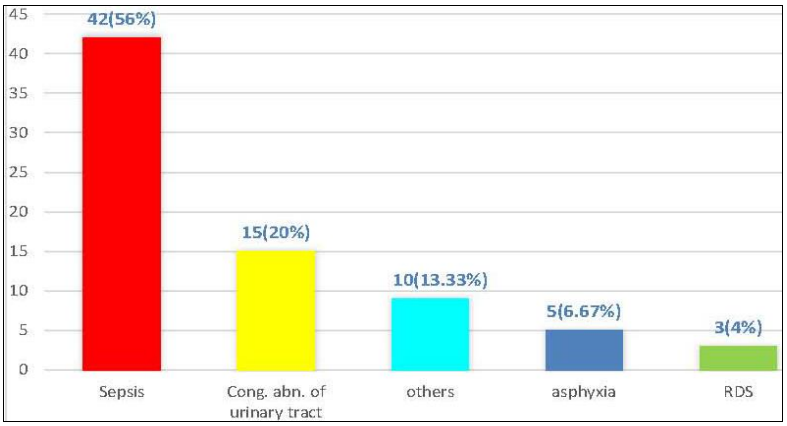

Fig 4: Predisposing factors of acute renal failure in neonate

Causes of ARF: The causes of ARF was prerenal failure in 23 neonates (31%) and renal in 37 neonates (49%) and post renal in 15 neonates (20%) as shown in figure (5)

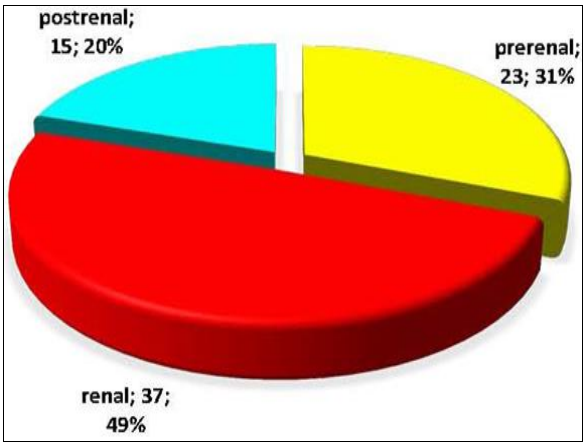

Fig 5: Causes of acute renal failure in neonates

Type of treatment

The neonate who had ARF and included in the study treated by conservative treatment (correction of dehydration if present with fluid, treatment of acidosis if present, correction of electrolytes such as hyperkalemia or hypocalcaemia, use of diuretics) if the above measure fail we use renal replacement therapy (RRT) such as peritoneal dialysis (PD) in the studied group 16(21%) need PD while 59 (79%) treated conservatively as shown in figure (6) below.

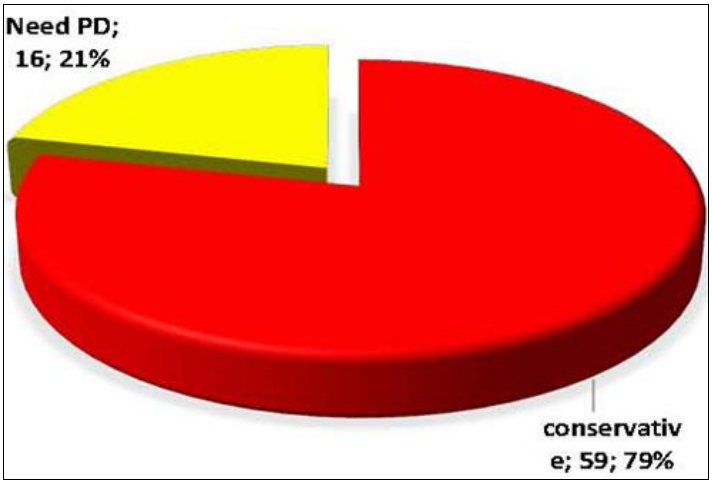

Fig 6: Type of treatment of acute renal failure in neonates

Regarding the outcome of the neonate who included in the study; 44 (58.67%) discharged with normal renal function, 4 (5.33%) referred to other hospital (due to availability of dialysis fluid), 17 (22.6) were discharged with abnormal renal function and 10 (13.33%) died the above result shown in figure (7) below.

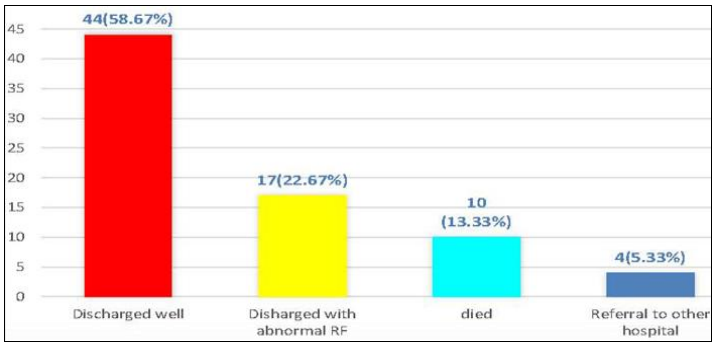

Fig 7: Outcome of Acute renal failure in neonate

Discussion

Acute renal failure (ARF) remains a significant concern in neonatal care units, as highlighted in the recent research conducted in Babylon Teaching Hospital for maternity and children. The incidence rate of ARF in this study was 3.39%, which is consistent with global figures that report incidence rates between 1-24% [13, 14]. Comparable studies in countries like India and Thailand also report similar findings, with incidence rates of 3.8% and 6.3%, respectively [15, 16]. Demographic data revealed a male predominance in ARF with a male to female ratio of 1.68:1, aligning with findings from other studies, suggesting that males might be more susceptible to certain perinatal disorders such as sepsis [19-21]. The majority of the neonates in this study were term, which is consistent with studies conducted by Nariman and Mortazvi [19, 20]. Furthermore, when looking at the timing of ARF onset, a significant number developed the condition after two weeks of life, differing slightly from the findings of Bolat *et al*. [21]. The most frequent type of AKI in this study was non-oliguric, which is in line with Karlowicz and Adelman's research [22] but varies from reports of other researchers [20, 23]. The study suggests that the quality of patient management might account for this variance. A notable outcome from this study was the high frequency of intrinsic renal failure, contrasting with some studies but mirroring the findings of Mortazavi *et al*. [20]. A crucial insight from the study was that sepsis emerged as the most significant predisposing factor to ARF, underscoring the critical importance of infection control measures in neonatal care units [24, 25]. Dialysis treatment, although available, was not the primary treatment method, with 21% of patients undergoing peritoneal dialysis. This contrasts sharply with Nariman *et al.*'s findings, where 44% of patients required dialysis [19]. The mortality rate was found to be 13.3%, which sits between other recorded rates from different studies [26, 27].

Conclusion

Acute renal failure (ARF) is a pressing concern in neonatal care units. This study at our hospital showed that intrinsic kidney failure is the predominant type of ARF, with sepsis being the leading risk factor and cause of death. It's crucial to promptly identify and assess neonates at risk, such as those with asphyxia, sepsis, dehydration, and heart failure. Utilizing straightforward tests like blood urea and serum electrolytes can aid in early ARF detection, offering a cost-

effective alternative to renal replacement therapy. Proper nursing care is vital for improved outcomes, and there's a need for extended studies to monitor these babies long-term.

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Author's Contribution
Not available

Conflict of Interest
Not available

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Not available

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