ACUTE RENAL FAILURE IN A TEACHING HOSPITAL

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ABSTRACT

This was a retrospective study of the clinical course of 164 adult inpatients with acute renal failure (ARF) at the Hospital of the University of Science Malaysia admitted from June 1986 to May 1990. The mean age was 49.8 ± 17.2 years. 33.5%, 54.9% and 11.6% were surgical, medical and obstetrical patients respectively. Obstructive uropathy, poor cardiac output or decrease in intravascular volume and infection accounted for more than 67% of the cases. Acute renal failure was present at admission in 113 (69%) patients. The majority of the patients (80%) had nonoliguric acute renal failure with daily output of urine of more than 400 ml. Compared with nonoliguric patients, oliguric patients had higher mortality (56.3% vs 18.9%, p<0.01), and needed dialysis more frequently (43.8% vs 12.9%, p<0.01). Early recognition of acute renal failure, improvement in early treatment of renal stones and discerning use of nephrotoxic drugs could result in decrease in incidence and severity of renal failure.

Keywords: acute renal failure (ARF), oliguria, community acquired acute renal failure, obstructive uropathy.

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INTRODUCTION

Acute renal failure (ARF) remains a serious disorder despite advances in medical treatment. Case mortality has remained in the region of 40% - 60%[1-4] over the last 20 years. It has occurred quite frequently in the setting of large general hospitals[5-7]. The 3 studies of Malaysian patients treated in the Kuala Lumpur General Hospital were done at 1976-1981 and 1987[7-9]. The population served by the Hospital of University Science of Malaysia consisted of a predominant Malay racial group which is different from the other three studies. There is also a need to study this clinical syndrome that changes continually with advances in medical practice with the ultimate aim of prevention, early detection and improved therapy of the disease.

This study on ARF in adult hospital inpatients aimed to achieve the following :

1. elucidate the clinical characteristics, aetiologies, treatment and mortality of the disease,
2. suggest ways of improved prevention and treatment.

MATERIALS AND METHODS

This was a retrospective study over the four-year period from June 1986 to May 1990 on adult inpatients (more than 12 years old) at the Hospital of the University of Science Malaysia. Inclusion criteria were :

1. serum creatinine level of more than 177 umol/l occurring during hospital stay with a previously normal serum creatinine (normal range in our laboratory, 62 - 124 umol/l) or recovery of renal function with normal serum creatinine at discharge. Serum creatinine of 177 umol/l corresponds to 2 mg per decilitre which is the cut-off value defining ARF in a number of studies[3-5], or
2. a two-fold rise in serum creatinine occurring during hospital stay with previous impaired renal function of creatinine more than 177 umol/l.

The laboratory records of renal function from June 1986 to May 1990 were scrutinised to produce a list of patients with serum creatinine levels more than 177 umol/l. Case records of these patients were studied retrospectively.

Oliguria was defined as a daily urine output of less than 400 ml. ARF was considered to be community acquired if renal function was abnormal on admission and hospital acquired if renal function which was normal on admission deteriorated during hospital stay.

The serum creatinine was measured by an autoanalyser. All data were expressed as mean ± SEM and statistical analysis was performed using Mann Whitney "U" test and chi-squared analysis.

RESULTS

A total of 164 patients admitted from June 1986 to May 1990 fulfilled the criteria and were included into the study. Over this period there were 79,196 adult admissions to Hospital University of Science Malaysia. This gave an incidence of 2 ARF patients per 1,000 admissions. Table I shows the age distribution. The mean age of these patients was 49.8 ± 17.2 years. 69.9% of the patients were over 40 years old. The majority of the patients were Malays (86.6%), followed by Chinese (12.2%) and Indians (1.2%). Males predominated at 61.6% and females 38.4%. The mean period of hospital stay were 29.1 ± 28.3 days. The aetiologies of ARF were grouped

Table I - Age distribution of patients with acute renal failure

Age range (years)	No.(%) of patients
<20	7 (4.3%)
21 - 40	42 (25.6%)
41 - 60	65 (39.6%)
>60	50 (30.5%)
Total	164 (100.0%)

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Table II - Primary events leading to acute renal failure (ARF)

Events or causes leading to ARF	No.	%
A. Medical-related ARF	*90*	*54.9*
1. Pre renal azotaemia	22	13.4
a. decrease in cardiac output	10	
b. diminished intravascular volume	12	
2. Infective	32	19.5
a. septicaemia	24	
b. pyelonephritis/urinary tract infections	8	
3. Toxin induced	8	4.9
a. aminoglycoside	7	
b. others	1	
4. Miscellaneous (refer to Table IV)	28	17.1
B. Surgical-related ARF	*55*	*33.5*
1. Obstructive uropathy	37	22.5
a. renal calculi	27	
b. bladder calculi/carcinoma	6	
c. prostatic carcinoma/hypertrophy	4	
2. Pre renal azotaemia	11	6.7
a. post operative	11	
3. Miscellaneous (refer to Table VI)	7	4.3
C. Obstetric-related ARF	*19*	*11.6*
1. Obstetric complications	11	6.7
a. Pre eclampsia	5	
b. abruptio placenta	3	
c. septic abortion	3	
2. Obstructive uropathy	8	4.9
a. cervical/ovarian carcubina	8	
Total	164	100.0

Table III - Miscellaneous causes of acute renal failure

Miscellaneous causes	No.
Multifactorial	15
Incompatible blood transfusions	3
Diabetic ketoacidosis	3
Chronic liver cirrhosis	3
Acute glomerulonephritis	2
Falciparum malaria infections	2
Multiple myeloma	2
Leptospirosis	3
Renal tuberculosis	1
Metastatic associated hypercalcaemia	1
Total	35

under 3 groupings ie surgical group, medical group and obstetric group. Table II shows the distribution of patients under each group and the primary events leading to renal failure. Miscellaneous causes of ARF accounting for 21.3% are listed in Table III.

Oliguric renal failure occurred in 32 patients (20%) with mean urine output of 203.1 ± 134.3 ml. The other 132 patients with nonoliguric renal failure produced mean urine flow of 1290.7 ± 970.1 ml/day. Table IV compared both groups with the oliguric patients having higher serum creatinine (737 ± 481 umol/l versus 561 ± 414 umol/l, $p<0.05$); requiring dialysis more frequently [14/32(43.8%) versus 17/132(12.9%), $p<0.01$]; occurring more frequently in intensive care and ventilated patients [13/32(40.6%) versus 18/132(13.6%), $p<0.01$]; and requiring mechanical ventilations [10/32(23.8%) versus 16/132(10.8%), $p<0.05$]; and with a higher mortality rate [18/32(56.3%) versus 24/132(18.2%), $p<0.01$].

One hundred and thirteen patients (68.9%) had ARF at admission while the other 51 patients (31.1%) who had normal renal function at admission acquired renal failure during the hospital stay. Table V compares these two group of patients. Obstructive uropathy predominated the community acquired ARF, and obstetric together with toxin induced cases occurred more frequently in hospital acquired ARF. Mortality of the two groups were not significantly different with 39.2% for hospital acquired ARF and 20.4% for community acquired ARF. However more patients with hospital acquired ARF patients required intensive care and mechanical ventilation compared with community acquired ARF [37.3% versus 10.6% and 38.6% versus 8% respectively].

Treatment by haemodialysis or peritoneal dialysis was necessary in 30 patients (18.3%). Thirty-one patients (18.9%) stayed in intensive care and 26 patients (15.9%) were ventilated. Forty-three patients died over this period, giving a mortality rate of 26.2%. Table VI shows the diagnostic groupings of patients who died. The largest groups consisted of post operative patients and patients with septicaemia.

DISCUSSION

Medical patients comprised the largest group of patients with ARF involving 54.9% of all patients. Other studies gave almost similar figures ranging from 41% to 54%[8,10,11]. This differed from earlier studies before 1975 which gave figures of approximately 60% surgical patients, 30% medical and 10% obstetric patients[12]. This is not surprising considering the larger turnover as well as varied spectrum of diseases with the majority of patients with long standing medical problems and better surgical and anaesthetic technique and better general supportive care. Further analysis did not reveal any difference in age, length of hospitalisation, frequency of dialysis and mortality between medical, surgical and obstetric patients with acute renal failure in this study.

Oliguria is commonly considered to be characteristic of renal failure. However 80% of the patients in this study had nonoliguric ARF. This result is consistent with other studies with figures of 60% - 78%[5,9]. Several explanations have been put forward which included routine renal function screening in hospitalised patients, the use of potent loop diuretics which seemed to be able to convert oliguric into nonoliguric ARF in some cases; and the use of drugs, particularly nephrotoxic drugs resulting frequently in nonoliguric ARF.

It is quite obvious that nonoliguric renal failure has a better prognosis. As seen in this study, creatinine levels were lower, affected patients needed dialysis less frequently and mortality was lower. It would seem advantageous to convert oliguric into nonoliguric renal failure[13].

Obstruction uropathy was the major single cause of ARF, accounting for 27.4% of all cases, with two-thirds of the cases secondary to renal stones. In patients studied at the

Table IV - Characteristics of patients with oliguric and nonoliguric acute renal failure (ARF)

Clinical data	oliguric ARF (n=32)	nonoliguric ARF (n=132)
1. Age (years)	48.1 ± 16.5	50.2 ± 17.5
2. Period of hospitalisation (days)	22.7 ± 16.5	30.7 ± 30.3
3. Aetiologies of ARF		
i. obstructive uropathy	8/32(25.0%)	37/132(28.0%)
ii. pre renal azotaemia		
a. decreased cardiac output	0/32(0%)	10/132(7.6%)
b. diminished intravascular volume	0/32(0%)	12/132(9.1%)
c. post operative	3/32(9.4%)	8/132(6.1%)
iii. infective		
a. septicaemia	5/32(15.6%)	19/132(14.4%)
b. pyelonephritis/UTI	0/32(0%)	8/132(6.1%)
iv. obstetric	4/32(12.5%)	7/132(5.3%)
v. toxin induced	0/32(0%)	8/132(6.1%)
vi. miscellaneous	12/32(37.5%)	23/132(17.4%)
3. Urine volume (ml/day)	*203 ± 134	1290 ± 970
4. Peak urea (mmol/l)	36.0 ± 13.9	32.4 ± 14.0
5. Peak creatinine (umol/l)	@737 ± 481	561 ± 414
6. No. of patients with hyperkalaemia (k>5 mmol/l)	16/32(50.0%)	49/132(37.1%)
7. Dialysis	#14/32(43.8%)	17/132(12.9%)
8. Mortality	#18/32(56.3%)	25/132(18.9%)
9. No. of patients requiring intensive care	#13/32(40.6%)	18/132(13.6%)
10. No. of patients requiring mechanical ventilations	@10/32(31.3%)	16/132(12.1%)

* $p < 10^{8}$, # $p < 0.01$, @ $p < 0.05$

nephrology unit at Kuala Lumpur General Hospital, 15% of 152 patients with ARF had obstructive uropathy[6]. This is a potentially reversible cause of ARF if the obstruction is relieved early. In this study, obstruction occurred almost exclusively before or at admission so that community acquired ARF would benefit most from ultrasonography of the kidney and pelvicalyceal system, with the aim of diagnosing obstructive uropathy and, if available, performing percutaneous nephrostomy.

Pre renal factors, the next most common cause of ARF, comprising post-operative decreased cardiac output and diminished intravascular volume, were potentially reversible. Careful maintenance of adequate intravascular volume with monitoring of central venous pressure would be helpful in prevention as well as treatment of these cases. The use of potent diuretics could pose a potential danger in inducing pre renal failure.

Septicaemia giving rise to ARF had a very poor prognosis. As seen in the study, 14/24 patients died, giving a mortality of 58%. These fatalities were usually seen in the setting of patients with multi-organ failure. The recent use of monoclonal antibodies towards endotoxin should be a positive step in an area that needs more effective treatment[14].

Obstetric causes of ARF, prevalent in the past, have decreased both in incidence and mortality. This could be attributed to better prenatal care, control of hypertension and better anaesthetic and surgical technique[15].

Drug-induced ARF is expected to continue to rise as more new drugs come into the market. In this study aminoglycosides remained the single most important culprit. Of the 8 cases, 7 were due to gentamicin and one due to amikacin. Serum drug levels were done in all cases and 2 were found to have toxic levels. All had nonoliguric renal failure. This finding would suggest that only carefully selected patients should be given aminoglycosides and drug levels should be carefully followed.

The overall mortality rate of 26% was comparable with other studies with rates of 18% to 35%[6,7,16]. The strategy of trying to lower this rate would include prevention, earlier diagnosis and treatment of both ARF and underlying disease and improved general supportive care.

In conclusion, ARF managed in the Hospital University of Science Malaysia did not differ in incidence, aetiology and mortality from other hospitals in Malaysia. There is a need to stress the preventive aspects of management of this disease with efforts directed especially towards treatment of renal calculus disease.

Table V - Characteristics of patients with community and hospital acquired acute renal failure (ARF)

	Clinical data	Hospital acquired ARF (n=51)	Community acquired ARF (n=113)
1.	Age (years)	46.8 ± 18.9	51.1 ± 16.4
2.	Period of hospitalisation (days)	30.5 ± 23.6	28.5 ± 30.2
3.	Aetiologies of ARF		
	a. obstructive uropathy	4/51(7.8%)	*41/113(36.3%)
	b. pre renal azoteamia	8/51(15.7%)	25/113(22.1%)
	c. infective	8/51(15.7%)	24/113(21.2%)
	d. obstetric	9/51(17.6%)	@ 2/113(1.8%)
	e. toxin induced	8/51(15.7%)	* 0/113(0%)
	f. miscellaneous	14/51(27.5%)	21/113(18.6%)
4.	Urine volume (ml/day)	990 ± 740	1117 ± 1062
5.	Urea at admission (mmol/l)	5.6 ± 1.8	#24.1 ± 13.3
6.	Creatinine at admission (uml/l)	135 ± 96	+504 ± 447
7.	Dialysis	10/51(19.6%)	20/113(17.7%)
8.	Mortality	20/51(39.2%)	23/113(20.4%)
9.	No. of patients requiring intensive care	19/51(37.3%)	@12/113(11.6%)
10.	No. of patients requiring mechanical ventilations	17/44(38.6%)	*9/113(8.0%)

$p < 10^{13}$, + $p < 10^{6}$, * $p < 0.001$, @ $p < 0.005$

Table VI - Diagnostic grouping of patient with acute renal failure who died

Diagnostic groups	No.
1. Septicaemia	14
2. Post operative	7
3. Polytrauma	4
4. Advanced carcinoma	4
5. Chronic liver disease	3
6. Cardiogenic shock	4
7. Obstructive uropathy	2
8. Diabetic ketoacidosis	2
9. Septic abortion	2
10. Pre eclampsia	1
Total	43

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REFERENCES

1. Mumurry SD, Luft FE, Maxwell DR, Hamburger RJ, Futty D, Szwed JJ. Prevailing pattern and predictive variables in patients with acute tubular necrosis. Arch Intern Med 1978; 138:950-5.
2. Butkus DE. Persistent high mortality in acute renal failure: are we asking the right questions? Arch Intern Med 1983; 143:209-12.
3. Shusterman N, Strom BL, Murray TG, Morrison G, West SL, Maislin G. Risk factors and outcome of hospital-acquired acute renal failure. Am J Med 1987; 83:65-71.
4. Kaufman J, Dhakal M, Patel B, Hamburger R. Community-acquired acute renal failure. Am J Kidney Dis 1991; 2:191-8.
5. Anderson RJ, Linas SL, Berus AS, Hendrich WL, Miller TR, Gabow PA. Nonoliguric acute renal failure. N Engl J Med 1977; 296:1134-8.
6. Hon SH, Buchrisky DA, Wish JB, Cohen JJ, Harrington JT. Hospital acquired renal insufficiency : a prospective study. Am J Med 1983; 74:243-8.
7. Suleiman AB. Clinical review of acute renal failure a 5 year experience at Kuala Lumpur. Ann Acad Med Singapore 1982; 11:2-35.
8. Suleiman AB, Yahya S. Acute renal failure in Kuala Lumpur. Med J Malaysia 1981; 36:11-3.
9. Suleiman AB, Zaki Murad, Prasad S. Prospective study of acute renal failure in a general hospital. Med J Malaysia 1987; 42:230-7.
10. Beaman M, Turney JH, Rodger RSJ, McGonigle RSJ, Adu D, Michael J. Changing pattern of acute renal failure. Q J Med 1987; 62:15-23.
11. Maher ER, Robinson KN, Scoble JE, Farrimond JG, Browne DRG, Sweny P, et al. Prognosis of critically-ill patients with acute renal failure : APACHE II score and other predictive factors. Q J Med 1989; 72:857-66.
12. Brenner BM, Lazarus JM, eds. Acute renal failure. Philadelphia : WB Saunders, 1983.
13. Honda N, Hishida A. Pathophysiology of experimental nonoliguric acute renal failure. Kidney Int 1993; 43:513-21.
14. Ziegler EJ, Fisher CJ Jr, Sprug CL, Smith CR, Sadoff JC, Dellinger RP. Treatment of gram negative bacteraemia and septic shock with HA-1A human monoclonal antibody against endotoxin - a randomised, double blind, placebo-controlled trial. N Engl J Med 1991; 324:429-36.
15. Grunfeld JP, Ganeval D, Bournerias F. Acute renal failure in pregnancy. Kidney Int 1980; 18:179-91.
16. Wheeler DC, Feehally J, Walls J. High risk acute renal failure. Q J Med 1986; 61:977-84.