A STUDY ON EPIDEMIOLOGY, CAUSES AND PROGNOSIS OF ACUTE RENAL FAILURE IN INDIAN POPULATION

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ABSTRACT

AIM

To study the Epidemiology various aetiological, precipitating factors, pattern of complications and the prognosis with reference to immediate outcome of acute renal failure cases.

MATERIALS AND METHODS

It was a prospective study under which fifty cases of acute renal failure admitted in various units of the Department of Medicine were studied under different parameters like age, sex, clinical presentation, causes, complication and prognosis in BGS Global Institute of Medical Sciences Hospital from 2013 to 2015. The outcome of ARF in each case was documented and percentages were calculated.

RESULTS

The most common cause of ARF in developing country being acute gastroenteritis 42% of cases, snake bite 28% of cases, malaria 6% of cases, hepatorenal syndrome 4% cases, obstetrics causes 4% cases, sepsis 4% and rest other causes being 2% each. The commonest complication being electrolyte imbalance among ARF cases. Out of the 50 cases studied, 17 died in the hospital suggesting a mortality of 34%; 14 patients were referred for dialysis and were lost to follow up (28%); 18 patients (36%) had complete recovery from ARF.

CONCLUSION

The most common cause of ARF is gastroenteritis, so simple remedial measures like using clean sanitary, drinking water, improvement of general hygiene, good obstetric care, control of mosquitoes and use of oral rehydration solution for diarrhoea can go a long way in decreasing the incidence of ARF in the developing world. Physician should be aware of the complication, close attention to haemodynamic, volume status and avoidance of nephrotoxic medications is important to have better outcome in ARF patient.

KEYWORDS

Acute Kidney Injury, Acute Renal Failure, Cause, Epidemiology, Prognosis.

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INTRODUCTION

Acute Renal Failure (ARF) often referred to as Acute Kidney Injury (AKI) is characterised by sudden (i.e. hours to days) impairment of kidney function. AKI now understood to be an increasingly common and potentially catastrophic complication in hospitalised patients.¹ There are many Western studies conducted on the causes and prognosis of ARF, but very few Indian studies. So this study was conducted with the aim being to study the Epidemiology, various aetiological, precipitating factors, pattern of complications and the prognosis with reference to immediate outcome of acute renal failure patients.

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MATERIALS AND METHODS

The present work is a prospective study conducted in BGS Global Institute of Medical Sciences Hospital from 2013 to 2015. This study consists of fifty cases with symptoms and signs of acute renal failure admitted under various units of the Department of Medicine.

Acute renal failure is defined as a deterioration of renal function over a period of hours to days, which results in an increase in serum creatinine of > 0.5 mg per decilitre over the baseline value, an increase of more than 50 percent over the baseline value or a decrease in renal function that results in the need for dialysis. Oliguria (Urine output of less than 400 mL/day) is a frequent but not invariable clinical feature. ARF may or may not be symptomatic.

Criteria for Selection of Patients

1. Patients who satisfied the above clinical criteria were included in the study.
2. Patients with signs and symptoms suggesting acute renal failure due to obstructive uropathy were excluded from the study after abdominal ultrasonography.

- Patients who presented with symptoms and signs suggesting prerenal ARF, who improved after correction of haemodynamic status within 24 hours were excluded from the study.
- Patients with past history of renal disease were excluded from the study.
- Only inpatients were included in the study.

A detailed history of the age, sex, socioeconomic status, presenting complaints were obtained; the chronological account of the problems, the treatments undergone prior to admission and associated symptoms were obtained. History of any pre-existing renal disease was obtained and patients were investigated for the underlying causes for ARF.

At the same time, patients were started on appropriate conservative therapy. Whenever possible the aetiological factors were treated or the offending agents withdrawn. Restoration of systemic and renal haemodynamic was undertaken with volume repletion when necessary.

The patient was monitored for the development of complications during the stay in the hospital, such as volume overload, oedema, symptoms and signs of uraemia, electrolyte and acid base disturbances, infection and septicaemia, anaemia and bleeding.

Patient was referred for dialysis if the patient had clinical or biochemical deterioration despite conservative therapy or when the patients presented with severe uraemia.

Other organ failure developing during the stay was documented. The outcome of the ARF and the patient in each case was documented and percentage was calculated.

OBSERVATIONS AND RESULTS

Fifty patients diagnosed to have ARF as per the criteria described previously were studied and the following observations were noted.

Age

The age of the patients included in the present study ranged from 13 to 82 years.

Age Group	No. of Patients	Percentage
12-25 Years	11	22%
26-40 Years	12	24%
41-55 Years	12	24%
> 55 Years	15	30%

Table 1: Showing the Distribution of Age among ARF Patients

Sex

Out of the 50 cases studied, 35 were males and 15 were females with a male:female ratio of 7:3.

Occupation

Out of 35 males 25 males were involved in agricultural activity, remaining in non-agricultural activity. Out of the 15 females, 7 were involved in agriculture activity.

Occupational Status

Sex	Agriculture	Non-Agriculture
Male	25	10
Female	7	8

Table 2: Showing Occupational Status of the Patients

Residence

Out of 50 patients, 40 came from a rural background.

Socioeconomic Status

Out of the 50 patients, 42 came from low socioeconomic status group and 8 from middle income group.

Wards where the Patients were Primarily Admitted

Out of 50 patients 45 patients were admitted under medical wards, 2 cases were referred from Obstetric Department (1 septic abortion, 1 pre-eclamptic toxemia), 2 cases were referred from Surgery Department (1 diabetes mellitus, gangrene foot and septicaemia, 1 abdominal angina) and 1 case from Orthopaedic Department (Crush injury of leg).

Delay in Presentation

The time from onset of the symptoms to the presentation to this hospital is documented.

- 17 cases (34%) presented within 1 day.
- 18 cases (36%) presented within 2 days.
- 11 cases (22%) presented within 3 days.
- 4 cases (8%) in 4 days.

Chronic Diseases Present in the Patients

COPD	3
Diabetes	3
Cerebrovascular Disease	1
Hypertension	3
IHD	2
Cirrhosis	1
Chronic Hepatitis B	1

Table 3: Showing the Chronic Diseases Present in the ARF Patients

Blood Pressure

Sys. BP (in mmHg)	<60 mmHg	<80 mmHg	<100 mmHg	>100 mmHg
No. of Patients	8	9	12	23

Table 4: Showing Systolic BP at Admission

Urine Output

Anuria	<400 mL/day	> 400 mL/day
12	38	0

Table 5: Showing the Lowest Urine Output (in 24 hours) during the Hospital Stay is Given Below

Urine Analysis

> 1.018	13
1.018 – 1.015	6
< 1.015	31

Table 6: Urine Specific Gravity given Below

Urine analysis suggesting prerenal azotaemia was seen in 26% and suggesting intrinsic renal azotaemia in 62%. Urine analysis was of diagnostic importance in only 1 case, which was diagnosed as glomerulonephritis and showed RBC casts, proteinuria and RBCs.

Blood Urea and Serum Creatinine

The blood urea values ranged from 56 to 296 mg% with mean of 71.6 mg%. The serum creatinine values ranged from 2.0 to 19.2 mg% with mean of 2.8 mg%.

Electrolytes

- Hyponatraemia (<135 mmol/L) -----18 cases.
- Hypernatraemia (>145 mmol/L)-----2 cases.
- Hypokalaemia (<3.5 mmol/L) ----- 1 cases.
- Hyperkalaemia (7.5 mmol/L)-----9 cases.
- Hypocalcaemia (<9 mg%) ----- 1 case.

Underlying Aetiology of ARF

Sl. No.	Cause for ARF	Number of Cases	Percentage
1	Acute Gastroenteritis	21 cases	42% of the cases
2	Snake Bite	14 cases	28% of the cases
3	Malaria	3 cases	6% of the cases
4	Hepatorenal Syndrome	2 cases	4% of the cases
5	Obstetric Causes (1 Septic Abortion 1 Pre-Eclamptic Toxaemia)	2 cases	4% of the cases
6	Sepsis	2 cases	4% of the cases
7	Crush Syndrome	1 cases	2% of the cases
8	Cardiogenic Shock due to MI	1 cases	2% of the cases
9	Abdominal Angina known IHD	1 cases	2% of the cases
10	Glomerulonephritis	1 cases	2% of the cases
11	Gangrene Leg Diabetes Mellitus	1 cases	2% of the cases
12	Malignant Hypertension	1 cases	2% of the cases

Table 7: Shows the Causes in Descending Order of Frequency

Duration of Stay in the Hospital: The mean duration of many in the hospital was 4 days. The maximum duration of stay was 26 days and the minimum was 1 day.

Complication of ARF

Complications	No. of Cases
Volume Overload	16
Anaemia	10
Bleeding	1
Infection	13
Electrolyte Disturbances	31
Uraemia	14

Table 8: Showing the Complication of ARF Developed in the Patients included in the Study

Dialysis: The number of patients referred for dialysis because of clinical deterioration or development of complication was 14 (28%).

Country	Authors	Year	No. of Pts	Med %	Obst %	Surgical %
USA	Hall et al ⁶	1970	186	35	8	57
France	Klienkecht et al ⁷	1972	500	26	28	46
U.K.	Kennedy et al ⁸	1973	251	22	25	53
U.K.	Kerr et al ⁹	1974	503	40	11	49
Australia	Rasmussen et al ¹⁰	1985	148	43	0	57
Canada	Lein et al ¹¹	1985	58	50	0	50
USA	Abrea et al ¹²	1985	46	41	2	57
U.K.	Beaman et al ¹³	1987	250	50	3	47
USA	Corwin et al ¹⁴	1987	51	50	0	50
USA	Shusterman et al ¹⁵	1987	34	53	3	44
U.K.	Wheeler et al ¹⁶	1988	408	60	2	33

Table 11: Showing Pattern of ARF in Developed Country

Other Organ Failure Developing During Admission Were

Organs Involved	No. of Cases
Respiratory Failure	5
Heart Failure	3
Liver Failure	2
Septicaemia	7

Table 9: Showing Organ Failure Developed in ARF Patients during Admission

Outcome

Out of the 50 cases studied, 17 died in the hospital suggesting a mortality of 34 percent; 14 patients were referred for dialysis and were lost to follow up (28%); 18 patients (36%) had complete recovery from ARF. Out of 21 gastroenteritis cases, 13 had complete recovery in hospital; 5 were referred for dialysis and 3 died in the hospital. Out of 14 snake bite patients 5 patients had complete recovery, 4 patients died and 5 patients were referred for dialysis and lost for followup.

Complete Recovery	18 Cases	36%
Referred for dialysis	14 cases	28%
Mortality	17 cases	34%

Table 10: Showing the Outcome of the Study

DISCUSSION

The aetiology, course and outcome of ARF are closely linked to the prevailing socioeconomic and environmental conditions in a given geographic location. Consequently, a large disparity exists between the aetiology of acute renal failure in the economically advanced countries with temperate climates and that in the third world countries with limited resources and exposure to tropical conditions.

The true incidence of ARF in the community is available only from limited geographical zones. A survey of 32 centres engaged primarily in chronic dialysis in Europe, North Africa and Middle East revealed that 29 patients/million/year required acute dialysis. Comparable data however are not available from most tropical countries. If referrals to the dialysis units are a reliable guide, the condition is far more frequent in Asia (Chugh et al 1991).² The question regarding the incidence of milder forms of ARF has been addressed by only three studies (Hou et al³ 1983, M.J. Hanley et al⁴ 1981, Kumar et al⁵ 1973), whereas 2–4% of all hospital admissions had ARF of varying severity, only 8–14% of these required dialytic support.

Patterns of ARF

The contribution of medical, surgical and obstetrical conditions to the overall pattern of ARF in the tropics is distinctly different from that observed in the West.

Analysis of ARF in the West prior to 1980 revealed that 8–28% of cases were due to obstetric complications, while 22–40% and 46–57% were due to medical and surgical conditions respectively. (Hall 1970,⁶ Kleinknecht 1972,⁷ Kennedy 1973⁸ and Kerr 1974⁹). During the same period, 15–29% of ARF in the tropical countries was due to obstetric events, while the contributions of medical and surgical ARF were 58–67% and 4–24% respectively. (Ku 1975,¹⁷ Firmat 1975,¹⁸ Sitprijia 1975,¹⁹ Adu 1976,²⁰ Chugh 1978²¹ and Scedat 1978²²). Thus, in the previous two decades the main disparity in the pattern of ARF between the developed and developing countries was the preponderance of surgical ARF in the West and medical ARF in the tropics. The incidence of Obstetric ARF was not appreciably dissimilar.

Rapid advances in medical care in the industrialised nations have led to the virtual eradication of obstetric ARF which now constitutes less than 3% in all cases of ARF. Although, the relative contribution of medical and surgical ARF has not changed appreciably, there has been a steady increase in the mean age of patients with ARF and a tendency for patients with severe illnesses to survive long enough to develop ARF. (Rasmussen 1985,¹⁰ Lein 1985,¹¹ Beaman 1987,¹³ Corwin 1987,¹⁴ Schusterman 1987¹⁵ and Wheeler 1988¹⁶). Thus despite advances in dialysis and critical care, the mortality of ARF continues to be in the range of 36–72% with patients dying not from ARF, but with ARF (Hall J 1970⁶ and Eliahou 1964²³).

In the tropics too changes have occurred in the pattern of ARF, albeit at a less impressive pace when compared to the West (Chugh K.S. 1978,²¹ Rashid 1988²⁴ and Perriera 1988²⁵). In North India, Obstetric ARF is declined from 21–22% in the

past to 9% in recent years. During the same period, surgical ARF has increased from 11% in the 1960s to 24% in the 1970s and 30% in the 1980s. The contribution of acute renal failure from medical causes has remained between 55–67% of all cases of ARF, whereas sepsis, nephrotoxic drugs, open heart surgery in poor risk patients, cardiogenic shock and severe trauma following industrial and traffic accidents have emerged as the leading cause of ARF in developed countries (Rasmussen 1985,¹⁰ Lein 1985,¹¹ Beaman 1985¹³ and Schusterman 1987¹⁵). The tropical hospitals continue to be inundated by patients with ARF due to diarrhoeal disease, obstetric to be inundated by patients with ARF due to diarrhoeal disease, obstetric complications and environmental agents specific to this region (Shah 1985,²⁶ Muthusethupathi 1987²⁷ and Perriera 1988²⁵).

In this study only patients admitted under medical wards were taken up for analysis; 50 cases were studied. The incidence of ARF due to medical causes in this study is given below in descending order of frequency.

Diarrhoeal disease (21 cases)	-	42%
Snake bite (14 cases)	-	28%
Malaria (3 Cases)	-	6%
Sepsis (2 Cases)	-	4%
Hepatorenal syndrome (2 cases)	-	4%
Glomerulonephritis (1 case)	-	2%
Obstetric cases (2 cases)	-	4%
Miscellaneous (5 cases)	-	10%

The mortality rate in our study was 34% (17 cases). These data are compared with other studies.

Country	Authors	Year	No. of Pts	Med %	Obst %	Surg %
Singapore	Ku et al ¹⁷	1975	143	60	16	24
Indonesia	Oesman et al ²⁸	1975	48	63	29	8
Argentina	Firmat et al ¹⁸	1975	1000	58	28	14
Thailand	Sitprijia et al ¹⁹	1975	162	61	15	24
Ghana	Adu et al ²⁰	1976	50	62	24	4
India	Chugh et al ²¹	1978	325	67	22	10
S. Africa	Seedat et al ²²	1978	150	65	25	10
India	Shah et al ²⁶	1985	816	56	23	21
India	Muthusethupathi ²⁷	1987	187	85	9	6
India	Chugh et al ²⁹	1987	1862	60	15	25
Bangladesh	Rashid et al ²⁴	1988	70	75	9	16

Table 12: Pattern of ARF in Developing Countries

1. Chugh K.S. et al from PGIMER Chandigarh.

Causes	Period A 1965 – 74	Period B 1978–80	Period C 1981 – 86
Diarrhoeal Diseases	23%	12%	10%
G-6-P D Deficiency (IV Haemolysis)	12%	12%	6%
Snake Bite	3%	3%	2%
Copper Sulphate Poisoning	5%	2%	1%
Glomerulonephritis	11%	9%	10%
Drugs and Toxins	4%	5%	7%

Sepsis	2%	1%	8%
Miscellaneous	7%	8%	13%
Percentage of Total ARF	67%	55%	61%
Medical Causes	218	283	623
All patients	325	510	1027

Table 13: Showing the Medical Causes of Acute Renal Failure – Chandigarh Study³⁰

The mortality rates in this series was 41.8%. One important fact about the series was that only dialysed patients with ARF were included in the study.

2. In another study of 187 patients with ARF conducted by Muthusethupathi et al in 1987 from Govt. Royapettah

Hospital, Madras, the following were the aetiological causes.²⁸

Gastroenteritis (44 Cases)	-	26%
Leptospirosis (10 Cases)	-	4.8%
Snake Bite (6 Cases)	-	2.8%
Glomerulonephritis (49 Cases)	-	26%
Copper Sulphate (21 Cases)	-	4.8%
Hepatorenal Syndrome (2 Cases)	-	11%
G-6-PD Deficiency (1 Cases)	-	1%
Drug Induced (10 Cases)	-	0.5%
Sepsis (5 Cases)	-	5.3%
Obstetric (17 Cases)	-	9%
Miscellaneous (19 Cases)	-	10%
Total 187 Cases		

In this study, management of ARF was by conservative methods. It was found that, about one-third of patients with ARF can be managed by conservative measures alone. For nearly three fourths (71.6%), dialysis was required. The overall mortality in this series was 27.8%.

It was observed that other common tropical conditions like glomerulonephritis, leptospirosis and copper sulphate poisoning are important causes of ARF in Tamil Nadu.

It was also observed that G-6-PD deficiency causing intravascular haemolysis and ARF was rare in South India (1 case) as compared to Northwest of India (Chandigarh study),³⁰ where there was a higher incidence (12% of cases).

Another observation is that leptospiral ARF is common in South India and rare in North India. This has been substantiated by another study by Kasivishweshwaran et al from Kerala.²⁹ Other studies from Singapore and Thailand (Sitprija et al 1975¹⁹ and Ku et al 1975¹⁷) has found that leptospirosis is responsible for over 50% of patients with ARF in these countries. The incidence of pregnancy related ARF was almost similar in the 2 studies of Muthusethupathi²⁷ and Chugh.³⁰

Comparison of our Study with these 2 Studies has shown that

1. Diarrhoeal diseases, snake bites and malaria were the most important aetiological causes of ARF in our study.
2. Cases of suicidal copper sulphate poisoning, leptospirosis and glucose 6-phosphate dehydrogenase deficiency with intravascular haemolysis were not found in our study.
3. Obstetric case of ARF was 4% in our study compared to 9% of cases in Muthusethupathi's²⁷ study and 9–22% in the Chandigarh study by Chugh.³⁰
4. Drug-induced ARF was not seen in our study as compared to 5.3% in the Muthusethupathi study²⁸ and 4–7% in the Chandigarh study.³⁰

This can be explained because only patients with severe acute renal failure were included in our study. In nephrotoxic ARF due to drugs there is preservation of urine flow, so called non-oliguric ARF and it usually manifests as asymptomatic rises in blood urea and serum creatinine and also imparts a lower mortality. But despite widespread use of nephrotoxic medications (ACE inhibitors, NSAIDs), the cause of ARF

attributed to these was not statistically significant in the Indian studies as compared to Western studies.

5. There was a rarity of surgical causes (Other than obstructive uropathy) of ARF in our study. This is also conspicuous in the study of Chugh et al²⁹ from Chandigarh and Muthusethupathi et al²⁷ from Madras. The probable reasons are: (1) Lack of awareness of postoperative non-oliguric renal failure on the part of surgical staff, (2) Unwillingness to take up seriously ill patients for surgery, (3) Most cases of mild post-operative renal failure are mixed because of failure to do routine investigations.
6. Conservative therapy was helpful in 38% of our cases, similar to that of study by Muthusethupathi et al,²⁷ where 33% of patients recovered by conservative measures alone.
7. The mortality of 34% in our study cannot be compared with that of other studies (Muthusethupathi 27.8%²⁷ and Chugh et al 4.8%³⁰), because 28% of our patients were referred for dialysis and were lost for followup.

Summarising, the Important Facts to be Noted about ARF in our Country are

1. There was a significant delay in presentation to the hospital, which can be avoided by education of the general public. Delay in presentation affected outcome.
2. The poor socioeconomic conditions, malnutrition, lack of clean, sanitary, drinking water supply and inadequate medical facilities are some of the myriad factors responsible for the wide prevalence of diarrhoeal diseases in third world countries. Preventive measures should entail general improvement in the standard of living and early presentation to the hospital.
3. Snake bite is an occupational hazard in the rural areas of the tropics. The most common species causing acute renal failure are Russell's viper and saw scaled viper (*Echis carinatus*). Patients present with a classical history of local swelling, bleeding diathesis and ARF. Timely administration of antivenin in adequate amounts and prompt replacement of blood and fluid losses could conceivably prevent or alternate ARF.
4. Infections are common precipitants of ARF in the tropics. Examples include malaria and leptospirosis. Control of mosquitoes and avoidance of urine and tissues from infected animals, rodent control and avoidance of recreational activities in contaminated water are preventive measures.
5. Obstetric ARF has high incidence in developing countries. The reasons for the continued high incidence are inadequate antenatal, intranatal and postnatal care, prevalence of unsafe home delivery practices and clandestine abortions conducted by untrained personnel. The abortion practices include use of a stick, insertion of abortifacient chemicals and pastes, soap solutions and dilatation and curettage caused under unhygienic conditions.

There has been a decline in the incidence of obstetric ARF over the last care, legalisation of abortion (in 1972), improvement in operative techniques, availability of potent antibiotics and decline in use of the traditional midwife (Dai) for deliveries.

CONCLUSION

ARF is a condition in which despite rational supportive and replacement therapy, the mortality rate is still high (Approx. 50%).

The pattern of ARF in the third world countries is different from that in the developed countries. The common conditions causing ARF in tropics include acute gastroenteritis, infectious diseases, snake bite and pregnancy related causes.

Simple remedial measures like using clean sanitary, drinking water, improvement of general hygiene, good obstetric care, control of mosquitoes and use of oral rehydration solution for diarrhoea can go a long way in decreasing the incidence of ARF in the developing world.

Delay in seeking treatment is an important factor in precipitating ARF and also was associated with adverse outcomes.

On the part of the physician, close attention to haemodynamic and volume status and avoidance of nephrotoxic medications is important.

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