

ORIGINAL ARTICLE

Study of Acute Renal Failure in Rhabdomyolysis

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Summary:

A total of twenty four cases of acute renal failure due to rhabdomyolysis were studied in Dhaka Medical College Hospital in last 3 years in terms of clinical presentation and biochemical parameters including prognosis after treatment. Mean age (mean±SD) were 32±10 years ranged from 22 to 72 years, male 22 and female 2 cases. Common presentation were anorexia, nausea & vomiting 22 (91.66%), decreased urine output 20 (83.33%), generalized body ache 12 (50%), painful swelling of limbs 6 (25%), fever 3 (15%), convulsion & fracture of lower limb 2 (8.33%) each and abdominal pain in one case. Main causes were physical assault 12 (50%), near-drowning 3 (12.5%), vigorous exercise 3 (12.5%), road traffic accident (RTA) 2 (8.3%), convulsion (epilepsy), self induced trauma, septicaemia and post partum eclampsia with convulsion 1 in each case. Mean haemoglobin was 11.66 gm/dl, total count of WBC 13400/ cu.mm. of blood with

neutrophil 77.38%, urinary albumin 1+ in 14 cases, 2+ in 10 cases and mean urinary RBC 4/HPF and pus cell (WBC) 6/HPF. Mean blood urea and serum creatinine were 161 mg/dl and 10 mg/dl respectively. Mean serum potassium (K⁺) 5.9 mmol/L (K⁺ > 6.0 mmol/L in 12 cases). Mean serum CPK was 2341 IU/L, LDH 1300 IU/L, aldolase 1636 IU/L, SGOT 199 IU/L, blood sugar 5.8 mmol/L. Among 24, six patients (25%) were treated conservatively and 18 (75%) received dialysis treatment. Fourteen (58.3%) patients were given peritoneal dialysis (IPD) and 4 (16.66%) received haemodialysis (HD). Twenty (83.33%) patients were cured completely and 2 patients (8.3%) were discharged with risk bond (DORB) and 2 patients (8.3%) died. Reversal of normal renal function was observed between 2 to 6 weeks. It is concluded that rhabdomyolysis may lead to acute renal failure and prognosis is good if adequate treatment is administered early including dialysis therapy.

(J Bangladesh Coll Phys Surg 2006; 24 : 93-96)

Introduction:

Rhabdomyolysis has been implicated as the cause of acute renal failure in approximately 5 to 7% of cases^{1,2}. Rhabdomyolysis may be defined as a clinical and laboratory syndrome resulting from skeletal muscle injury with release of muscle cell contents into the plasma. The increase plasma concentration of these released substances such as creatinine kinase (CK) permits the clinician to diagnose this syndrome. Muscle accounts for approximately 40% of total body mass and leads victim to wide variety of toxic, ischaemic, traumatic,

infectious, inflammatory and metabolic insult. The final result of this diverse assault may be muscle fibre dissolution or rhabdomyolysis. The rhabdomyolysis syndrome has been recognized for centuries, however it was not until By-waters and Beall's classic description of the "Crush-syndrome", as a result of bombing raids of London during the World War-II that the renal complications of rhabdomyolysis became firmly entrenched in the medical literature³. This study was undertaken to determine the clinical presentation, etiology, biochemical parameters including prognosis after treatment of the patients of acute renal failure due to rhabdomyolysis.

Materials and Methods:

This study was carried out in the department of Nephrology, Dhaka Medical College Hospital from July 2002 to June 2005. A total number of 24 cases of acute renal failure due to rhabdomyolysis (male = 22, female = 02) were studied. Rhabdomyolysis was diagnosed by history, clinical features and laboratory investigations. Renal failure was defined as an acute loss of renal function as evidenced by serum creatinine level equal or greater than 2.0 mg/dl; other causes of acute renal failure or chronic kidney diseases (CKD)

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has been excluded from the study. The biochemical definition of rhabdomyolysis was when serum creatine phosphokinase (CPK) was >500 IU/L at any time of the presentation. The enzyme elevation due to myocardial infarction (MI), cerebral infarction or immediate post operative period was excluded from the study. The causes of rhabdomyolysis were ascertained from the history, and on the basis of clinical presentation and biochemical parameters. Laboratory investigations included complete blood count with hemoglobin percentage, urine routine and microscopic examination, serum phosphokinase (CPK), LDH, aldolase, urea, creatinine, electrolytes, random blood sugar, albumin, calcium, phosphate, ultrasound study of KUB and other relevant investigations where necessary. All patients received conservative treatment and dialysis treatment, in the form of intermittent peritoneal dialysis or haemodialysis, was offered on the basis of clinical and biochemical indications. Conservative treatment includes fluid restriction, antibiotics, anti-hypertensive and dopamine drip in oliguric phase. Diuretic phase was carefully managed with fluid and electrolytes replacement. The clinical indications for dialysis were anorexia, nausea, vomiting, fluid overload, respiratory distress, drowsiness and decreased urine output. Indications of biochemical parameters for dialysis were serum creatinine level > 7.0 mg/dl, urea >120 mg/dl with or without potassium (K⁺) level > 6.0 mmol/L in conjunction with clinical indications.

Results:

A total of 24 cases were diagnosed as acute renal failure due to rhabdomyolysis in the Dept. of Nephrology in Dhaka Medical College Hospital during July 2002 to June 2005. The mean age (mean ± SD) was 32 ± 10 years ranged from 22 – 70 years, male 22 and female 02 cases. The common presentations were anorexia, nausea & vomiting 22 (91.66%), decrease urine output 20 (83.33%) cases, hypertension 13 (54.16%) (Hypotension in 02 cases and remaining 09 cases were normotensive), generalized body ache 12 (50%), painful swelling of the limbs 06 (25%), fever 03 (12.5%), convulsion and fracture of lower limb 02 (8.33%) cases each and abdominal pain in one case (Table-I).

Table-I

Clinical variables in patients with rhabdomyolysis with acute renal failure.

| Variable | n = 24 | Percentage |
|----------------------------------|---------|------------|
| Age in yrs (mean±SD) | 32 ± 10 | |
| Male | 22 | 91.66 |
| Female | 02 | 8.33 |
| Anorexia, nausea, vomiting | 22 | 91.66 |
| Decrease urine output | 20 | 83.33 |
| Hypertension* | 13 | 54.16 |
| Gen. body ache | 12 | 50 |
| Painful swelling of limbs | 06 | 25 |
| Fever | 03 | 12.5 |
| Hypotension* | 02 | 8.33 |
| Convulsion & fracture of limbs - | 02 | 8.33 |
| Abdominal pain | 01 | 4.16 |

* Hypertension if BP ≥ 140/90 mmHg and hypotension if SBP < 100 mmHg.

Main causes of rhabdomyolysis were physical assault 12 (50%), near-drowning 03 (12.5%), vigorous exercise 03 (12.5%), road traffic accident (RTA) 02 (8.33%) and convulsion (epilepsy), self induced trauma, septicemia, post partum eclampsia with convulsion one in each cases (Table-II).

Table-II

Causes of rhabdomyolysis leading to ARF (n = 24).

| Causes | Number | Percentage |
|--------------------------------------|--------|------------|
| Physical assault | 12 | 50 |
| Near-drowning | 03 | 12.5 |
| Vigorous exercise | 03 | 12.5 |
| Road traffic accident (RTA) | 02 | 8.33 |
| Convulsion (Epilepsy) | 01 | 4.16 |
| Self induced trauma | 01 | 4.16 |
| Postpartum eclampsia with convulsion | 01 | 4.16 |
| Septicaemia | 01 | 4.16 |

Analysis of the laboratory variable shows mean hemoglobin was 11.66 gm/dl, total count of WBC 13,400/cu.mm of blood with neutrophil 77.38%, urinary albumin 1+ in 14 cases and 2+ in 10 cases and mean urinary RBC 04/HPF, WBC 06/HPF, urinary cast was present in 16 cases, blood urea 161 mg%, creatinine 10 mg%, potassium 5.9 mmol/L (K⁺ > 6.0 mmol/L in 12 cases), serum CPK 2341 IU/L, LDH 1300 IU/L, aldolase 1636 IU/L, SGOT 199 IU/L, blood sugar 5.8 mmol/L, calcium 8.1

mg/dl, phosphate 6.8 mg/dl, uric acid 8.1 mg/dl, albumin 37.5 gm/L, anion gap 22.2 ± 5.5 and kidney size as measured by ultrasound study shows mean length was 9.2 ± 2.5 cm with loss of cortico-medullary differentiation (Table-III and IV). ECG was done in all cases and in 06 cases were evidence of hyperkalemic changes was observed.

Among 24 patients, 6 patients (25%) treated conservatively; remaining 18 patients (75%) received dialysis treatment. Fourteen patients (58.3%) were given intermittent peritoneal dialysis (IPD). Out of these 14 patients, 10 cases required only one session of IPD and remaining four (16.66%) cases received more than 2 sessions of IPD. Haemodialysis (HD) was given in four cases (16.66%). Among them 3 patients were given 4 sessions of HD, 1 patient received 6 sessions of HD.

Table-III

Laboratory variables of patients of rhabdomyolysis with acute renal failure.

| Laboratory variable | Mean \pm SD |
|---------------------------|------------------|
| Haemoglobin (gm/dl) | 11.6 \pm 2.09 |
| Total Count of WBC/ cu.mm | 13400 \pm 4556 |
| S. Creatinine (mg/dl) | 10 \pm 4.9 |
| S. Urea (mg/dl) | 161 \pm 110 |
| S. Potassium (mmol/L) | 5.9 \pm 1.9 |
| S. CPK (IU/L) | 2341 \pm 3366 |
| S. LDH (IU/L) | 1300 \pm 1050 |
| S. Aldolase (IU/L) | 1636 \pm 2758 |
| SGOT (IU/L) | 199 \pm 452 |
| RBS (mmol/L) | 5.8 \pm 1.16 |
| S. Calcium (mg/dl) | 8.1 \pm 1.9 |
| S. Phosphate (mg/dl) | 6.8 \pm 2.8 |
| Uric Acid (mg/dl) | 8.1 \pm 2.5 |
| S. Albumin (mg/dl) | 37.5 \pm 3.15 |
| Anion Gap (mmol/L) | 22.2 \pm 5.5 |
| Kidney Size (cm) | 9.2 \pm 2.5 |

Table-IV

Urinary findings of patients of rhabdomyolysis with acute renal failure.

| Urinary findings (n = 24) | |
|---------------------------|----------|
| Urinary albumin 1+ | 14 cases |
| 2+ | 10 cases |
| Urinary RBC | 04/HPF |
| Urinary WBC | 06/HPF |
| Urinary Cast | 16 cases |

Twenty patients (83.33%) were completely cured and two patients were discharged on risk bond (DORB) and only two patients expired.

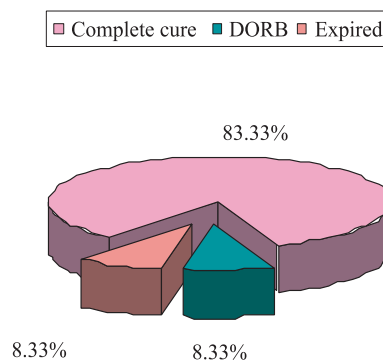


Fig-1: Pie diagram showing outcome of patients with rhabdomyolysis developing acute renal failure.

Discussion:

Incidence of acute renal failure due to rhabdomyolysis was reported approximately 5 to 7% in the literature^{1,2}. The incidence of renal failure in rhabdomyolysis varies in different study. In one study it was reported 16.5% (26 patients out of 157). The exact incidence of rhabdomyolysis is not known to us in our study because all the cases that included in this series were the patients who had developed acute renal failure. In other words, rhabdomyolysis without renal failure was not studied in this unit.

In this study the incidence of acute renal failure in rhabdomyolysis is 6.25% (24 cases out of 384 cases of ARF) in our centre. The three basic mechanisms underlying the myohaemoglobinuric renal injury are renal vasoconstriction, intraluminal cast formation and direct heme-protein induced cytotoxicity. The main clinical features were anorexia, nausea and vomiting (91.66%), decrease urine output (83.33%) and hypertension (60%). Other clinical features were generalized body ache (50%), painful swelling of the limbs (25%), fever (15%), hypotension (8.33%), convulsion with fracture lower limb (8.33%) and abdominal pain (4.16%). The predominant symptoms anorexia, nausea and vomiting were present in a higher percentage because all those patients who had developed ARF which may not be the main symptoms of rhabdomyolysis without renal failure. The percentage of hypertension in our study is 55% and hypotension 8.3%. Again the higher percentage of hypertension is due to the consequence of ARF which

is comparable with another study where hypertension was reported 46.2% in patients of rhabdomyolysis developing renal failure⁴. Oliguric renal failure developed in 83% of the patients and remaining 17% patients developed non-oliguric acute renal failure; 9 patients had oliguria for 2 days, 9 patients had oliguria for 5 days & above and 4 patients had oliguria for 3 days. This oliguric symptom was due to acute renal failure. Generalized body ache in 50% and painful lower limbs in 25% of cases and the cause of this symptom is due to physical assault and vigorous exercise in this study. Muscle pain and tenderness may vary according to the cause of rhabdomyolysis. In one study body ache was reported 28.73% whereas tender swelling of limbs was reported in 4.59% of cases⁵.

The causes of rhabdomyolysis were following categories in our study namely physical assault (50%), near-drowning (12.5%), vigorous exercise (12.5%), road traffic accident (8.3%), convulsion (epilepsy) (4.16%), self induced trauma (4.16%), post partum eclampsia & convulsion (4.16%) and septicaemia (4.16%). In some study alcohol is the leading cause of rhabdomyolysis⁵; other causes like ischaemia (arterial thrombosis, compartmental syndrome, prolonged immobilization), poly-myositis, drugs, viral illness were not noted in our study as because the study include only those cases of rhabdomyolysis developing acute renal failure. Two cases of acute renal failure due to rhabdomyolysis were reported, one was due to assault & another was due to prolonged exercise in Bangladesh^{6,7}.

All the cases had high level of phosphokinase (mean = 2341 IU/L). Lactate dehydrogenase (LDH) and aldolase were elevated (mean = 1300 & 1636 IU/L respectively) in 12 cases. The mean SGOT in our study was 199 IU/L. In one study it was reported 443 and 474 IU/L in cases of rhabdomyolysis with and without renal failure respectively⁵. Urinalysis showed 1+ albumin in 14 cases and 2+ albumin in 10 cases. Mean urinary RBC 04/HPF, WBC was 06/HPF and cast was present in 16 cases. Proteinuria was reported of varying ranges up to 90% of cases⁵. Proteinuria was due to presence of myoglobin itself and alteration of the glomerular permeability and tubular handling of low molecular protein⁸. Orthotoluidine dipstick test for detection of heme in myoglobin of urine was not estimated in our study. Hyperkalemia was present in all of our cases. The mean value was 5.9 mmol/l and in 12 cases K⁺ level was > 6.0 mmol/l. Similarly, inorganic phosphate was raised in all cases (mean = 6.8%), calcium was low in all cases (mean = 8.1%) and uric acid was elevated in all cases (mean = 8.3%). Serum potassium and

phosphate level may be normal in case of rhabdomyolysis without renal failure⁴. All the 24 cases had high level of urea and creatinine, the mean value were 161 mg/dl and 10 mg/dl respectively. All this patients had high anion gap and it was 22.2 ± 5.5 mmol/l. High CPK and phosphate level reflected the degree of muscle damage and high urea level and decreased bicarbonate level reflected degree of renal failure. Elevated urea, creatinine, uric acid and decreased bicarbonate level were due to presence of renal failure. All these patients were treated initially conservatively with fluid restriction, diuretic challenge and antibiotics. Later on 18 patients were treated with dialysis therapy; 03 patients were given 4 sessions of HD one patient received 6 sessions of HD and 14 patients were given intermittent peritoneal dialysis (IPD) therapy. Two patients expired, in one of them the cause of death was ARF as a result of rhabdomyolysis due to physical assault with multiple fractures in the lower limb. Twenty patients were completely cured as evident by normal renal function. Reversal of normal renal function was observed between 2 to 6 weeks. Time taken for reversal of normal renal function were 6 weeks, 4 weeks & 2 weeks in 4 cases, 14 cases and 2 cases respectively.

Conclusion:

It has been concluded that rhabdomyolysis may lead to acute renal failure and prognosis is good if adequate treatment is administered early including dialysis therapy.

References:

1. Grossman RA, Hamilton RW, Morse BM et al: Non traumatic rhabdomyolysis and acute renal failure. *N. Eng. J. Med* 1997; 291: 807-811.
2. Koffler A, Friedler RM, Massry SG. Acute renal failure due to non traumatic rhabdomyolysis; *Ann. Intern. Med.* 1976; 85: 23-28.
3. Bywater EGL, Beall D. Crush Injury with impairment of renal function; *Br. Med. J* 1941; 1: 427-432.
4. Michael M, Ward MD: Factors predicting acute renal failure in rhabdomyolysis. *Ann. Intern. Med* 1988; 148: 1553-1557.
5. Gabow PA, Kaehny WD, Kelleher SP. The spectrum of rhabdomyolysis; *Medicine.* 1982; 61: 141-152.
6. Ahmed S, Alam ME, Jahan RA: Acute renal failure due to rhabdomyolysis. *TAJ* 1998; 11: 36-38.
7. Ahsan HAMN, Ahmed S, Karim SR, Ahmed MN. Acute renal failure following prolonged exercise. *Bang. Renal J* 1999; 18: 25-27.
8. Ravnskov U: Low molecular weight Proteinuria in association with paroxysmal myoglobinuria; *Clin. Nephrol* 1975; 3: 65.