Non-traumatic rhabdomyolysis in patients with altered level of consciousness

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INTRODUCTION

Rhabdomyolysis (RML) develops as a result of damage to the skeletal muscular fibres. The damage is sufficient to alter the integrity of the sarcolemma, resulting in the release into the bloodstream of toxic intracellular components, including enzymes (creatine kinase [CK], lactate dehydrogenase [LDH], glutamic oxaloacetic transaminase [GOT]), haem pigment (myoglobin), electrolytes (potassium, phosphorus) and purines. The syndrome of rhabdomyolysis was first identified by Bywaters (1941), who described the clinical sequelae of the crush syndrome seen in multiple trauma patients injured during the bombing blitz in London, UK, in World War II. Bywaters identified acute renal insufficiency and compartmental syndrome as the principal complications.

Over the years, there have been an increasing number of reports of a non-traumatic form of RML (see Further Reading) (Table 1), which have increased our understanding of the underlying pathogenetic mechanisms (Majed Odeh, 1991; Vitris *et al*., 1991; Dayer–Berenson, 1994; Daras *et al*., 1995; Woodreow *et al*., 1995; Zager, 1996; Peng *et al*., 1998; Riggs, 1998; Szumilak *et al*., 1998; Desola *et al*., 1999; Guglielminotti *et al*., 1999; Hojs *et al*., 1999; Muthukumar *et al*., 1999; Viswesaran *et al*., 1999).

Perceived alterations in the level of consciousness (coma, alcoholic intoxication, and abuse of opium and hypnotic drugs) are often followed by prolonged abnormal body postures. These postures exert an extreme external pressure on muscle that can result in development of the RML syndrome (Szumilak *et al*., 1998). In order to understand the relationship between prolonged altered level of consciousness and RML, we conducted a prospective study of patients with an altered level of consciousness and non-traumatic RML. The study included the major causes, signs and symptoms related to non-traumatic RML, laboratory data and possible complications.

METHODS

A prospective 6-month study was performed from March to

Table 1. Causes of rhabdomyolysis

Aetiologies of rhabdomyolysis	Examples
Direct muscle injury	Crush syndrome (including pressure coma-induced necrosis), burns
Excessive muscular activity	Sports/military training, delirium tremens, seizures/myoclonus, acute severe asthma, prolonged cardiopulmonary resuscitation
Ischaemic necrosis	External compression, vascular occlusion
Drugs	Opiates, cocaine, amphetamines, LSD, ecstasy, barbiturates, phenothiazines, salicylate, neuroleptics, clofibrate, lovastatin, succinylcholine, ε-aminocaproic acid
Toxins	Ethanol, carbon monoxide, mercuric chloride, toluene, ethylene glycol, isopropyl alcohol, insect/snake toxins
Metabolic disorders	Diabetic ketoacidosis/non-ketotic hyperosmolar coma, water intoxication, hypothyroidism, hypokalaemia, hypophosphataemia, hypocalcaemia, hyponatraemia
Hereditary disorders	Glycogenolytic enzyme deficiencies (e.g. McArdle's syndrome), defective lipid metabolism (e.g. carnitine palmitoyltransferasecarnitine deficiency), muscular dystrophies
Immunological diseases	Dermatomyositis, polymyositis
Bacterial and viral infections	*Clostridium tetani*, *Legionella* spp., *Leptospira* spp., *Escherichia coli*, *Brucella abortus*, *Salmonella* spp., Epstein–Barr virus, echo/coxsackie virus, influenza, infectious mononucleosis and other infections
Others	Hypothermia and hyperthermia, electric shock, freezing, idiopathic, recurrent

September 2000, involving medical patients admitted to the Emergency department of our hospital. To be included in the study, patients had to satisfy both the following criteria:

- Altered level of consciousness, specifically the level of alertness (Glasgow Coma Scale ≤13)
- CK level > five times the upper normal limit (<235 U/l), myoglobin fraction <5%, negative troponin I.

Exclusion criteria was the presence of any of the following conditions:

- Acute myocardial infarction
- Recent surgery
- Trauma
- Acute cerebrovascular accident
- Chronic renal failure.

Admission procedure

Emergency department nurses and physicians were informed of the study so that all members of the health care team would systematically obtain vital signs and search for specific signs and symptoms.

Upon admission, a complete body systems examination was performed, with particular attention paid to the probability of RML either developing or being present. In unconscious patients, important signs indicative of the presence of RML were:

- Muscle hardening or swelling, even in the absence of skin colour changes
- Reddish or dark-brown ('cola')-coloured urine and/or oligoanuria
- A temperature higher than 38°C and 100°F.

Patients who had regained consciousness were asked for typical symptoms, such as myalgia, rigidity, weakness and painful myoedema.

Laboratory monitoring

Patients were monitored for the development of complications. In addition, all medical prescriptions were annotated, as well as the length of hospital stay. The level of recovery of patients was also assessed upon hospital discharge.

RESULTS

Of the 15,301 patients that came to the Emergency department during the time of the study, 32 patients were admitted with an altered level of consciousness and a score on the Glasgow Coma Scale ≤13. Eleven of the 32 patients were found to have signs indicating RML and were enrolled in the study. The incidence of patients with positive laboratory results for RML and none of the exclusion criteria was 0.072% of the patient population admitted to the Emergency department during the study period. The resulting population was composed of 10 males and one female, with a median age of 37.45±16.07 years (range 24–79 years). The causes of RML are listed in Table 2.

Nine of the 11 patients enrolled were admitted to hospital because of alcohol abuse, carbon monoxide poisoning, and other drug and substance abuse. Six of these patients had been addicted to drugs for several years, of whom three were undergoing methadone treatment. Two of the 11 patients had RML due to prolonged muscular compression as a result of generalised seizures. General findings upon admission to the study, with particular regards to Glasgow Coma Scale scores, specific signs and symptoms of RML and related complications, are outlined in Table 3. Tables 4 and 5 show the main laboratory values obtained.

Table 2. Baseline patient characteristics upon hospital admission*

Case	Age (yr)	Sex	Causes of rhabdomyolysis	Concomitant diseases and/or pre-existing conditions
1	60	M	Alcohol intoxication Chronic use of acetylsalicylic acid	Anxiety–depressive state Alcohol addiction Hypertension Valvulopathy
2	33	M	Alcohol/methadone/ flunitrazepam intoxication Forced position right leg	HIV+, HBV+, HCV+ Drug addiction
3	26	M	Heroin and methadone intoxication Forced position of lower limbs (crouched on legs)	HBV+ Drug addiction
4	24	F	Co-intoxication, seizures	Pregnancy
5	30	M	Heroin/methadone/ flunitrazepam intoxication Left periorbital wound	Drug addiction
6	33	M	Heroin intoxication Forced position with left-sided decubitus	HBV+, HCV+ Drug addiction
7	32	M	Alcohol/heroin/cocaine/ enzodiazepine intoxication Acute NSAID abuse	HCV+ Alcohol addiction Occasional substance abuse
8	36	M	Morphine intoxication Forced position left arm	Drug addiction
9	25	M	Benzodiazepine intoxication	Occasional amphetamine abuse
10	79	M	Transient ischaemic attacks Prolonged muscular compression Chronic benzodiazepines use	HCV+ Diabetes mellitus Type 2 Micro-multi-infarctual encephalopathy
11	34	M	Seizures Chronic use of phenytoin, lamotrigine, tiagabin	Partial complex epilepsy

*HBV+ = hepatitis B positive; HCV+ = hepatitis C positive; HIV+ = human immunodeficiency virus positive

In Table 4, it can seen that metabolic acidosis was determined by arterial blood gas analysis in six of the 11 cases. Serum CK (peak levels reached in all patients within 24–36 hours) and serum myoglobin values were elevated in all patients. Uric acid elevation occurred in five out of 11 cases.

Table 5 shows plasma creatinine and urea nitrogen trends, which were elevated in eight out of the 11 patients (72%). Five of the patients were oliguric. Only three patients showed a return to baseline values of renal efficiency. Case number 8 had a non-considerable minor elevation in serum CK, while urea nitrogen remained in a normal range. There was evidence of hyperkalaemia in five of 11 cases, with hypocalcaemia or borderline hypocalcaemia levels in nine of 11 cases. Case number 7 had hypercalcaemia (10.8 mg/dl) during the polyuric phase of acute renal failure (ARF). Hyperphosphataemia was observed in three of 11 cases, while hypophosphataemia was found in three of 11 cases.

Hepatic function was determined in all patients to exclude organ dysfunction and its involvement in possible multiorgan

Table 3. Baseline characteristics of patients upon hospital admission

Case	Consciousness content/level (Glasgow Coma Scale, GCS)	Muscular symptoms/signs*	Urinary symptoms/signs‡	General symptoms/signs⌐	Particular symptoms/signs
1	Confusion (GCS = 13)	NO	B	NO	NO
2	Stupor (GCS = 12)	YES (1 or 2)	B (on seventh day)	❖	NO
3	Stupor (GCS = 12)	YES (1 or 2)	B	◆	NO
4	Coma (GCS = 3)	NO	–	◆	NO
5	Coma (GCS = 3)	NO	NO	NO	Cardiorespiratory depression (bradypnoea, hypoxaemia, bradycardia)
6	Stupor preceded by loss of consciousness (GCS = 12)	YES (2)	B	◆	Neurological symptoms (leg and foot hypoaesthesia)
7	Stupor (GCS = 12)	YES (1)	B (for 3 days before hospital admission)	◆	Gastrointestinal illness (dyspepsia)
8	Stupor (GCS = 12)	NO	A	◆	Giant urticaria
9	Stupor and confusion (GCS = 13)	NO	NO	NO	NO
10	Confusion (GCS = 13)	NO	NO	❖	NO
11	Stupor (GCS = 12)	NO	NO	NO	NO

* (1) Myalgia, rigidity, weakness, contractures; (2) Painful myxoedema. ‡ (A) Reddish-brown- ('cola'-) coloured urine; (B) Oligoanuria.
⌐ ◆ Fever, 38°C (100.5°F); ❖ Dehydration; ◆ Hypotension

Table 4. Laboratory data for patients: part 1

Case	Metabolic acidosis	Creatinine kinase (CK) levels (normal level <235 U/l)			Myoglobin levels (normal range, 30–90 ng/ml)	Uric acid levels (normal range, 2.4–7.0 mg/dl)
		Admission	Peak	Discharge		
1	NO	5,513	5,513 <24 h	64 (8th day)	255 (4th day)	7.3
2	YES (in 7th day)	67,951	67,951 <24 h	233 (15th day)	17,713	10.7
3	YES	15,639	180,390 <24 h	927 (19th day)	–	9.3
4	YES	1,346	5,699 <24 h	1,151 (4th day)	270	6.2
5	YES	2,235	2,235 <24 h	19 (2nd day)	114 (2nd day)	5.8
6	YES	27,200	143,950 <36 h	218 (20th day)	–	8.5
7	NO	24,350	24,350 <24 h	1,033 (11th day)	–	12.4
8	NO	7,883	19,440 <24h	275 (7th day)	12,595	3.7
9	NO	477	1,178 <24h	680 (36 h)	289	6
10	NO	8,378	8,378 <24 h	175 (5th day)	4,550	4.3
11	YES	947	1,190 <24 h	233 (3rd day)	130	5.1

*If not specified, time of sampling is 'upon hospital admission'; creatinine kinase value obtained at maximum dilution available in laboratory so that the absolute value could be higher

failure (MOF). Coagulative screening tests were performed to exclude disseminated intravascular coagulation (DIC). Neither MOF or DIC occurred in any of the patients included in the study. An elevation in transaminase and LDH occurred in all patients, with peak levels reached in the same frame time as CK, denoting and confirming muscular injury. There was a transient low platelet count in case number 1. Table 6 listed the complications, therapy and length of stay for each patient.

Two patients (9 and 11) did not develop any complications. Oliguria indicating ARF complicated the clinical course of five of nine patients with toxic RML (case numbers 1, 2, 3, 6 and 7). Urgent dialysis was needed and continued for the next two to three weeks (median, 11 days). Non-oliguric ARF developed in one of nine patients with toxic RML and in one of two patients affected by non-toxic RML. Both were successfully treated with rehydration therapy alone.

Compartmental syndrome occurred less frequently than ARF; it developed in two patients (case numbers 2 and 3). Surgical procedures were started promptly in order to perform early decompressive fasciotomy.

Two patients developed pulmonary tract infections (case numbers 5 and 8), while one patient (case number 1) developed pulmonary oedema as a complication of carbon monoxide poisoning.

The average length of stay was 11 days, excluding the two patients with compartmental syndrome, whose length of stays were 65 and 80 days.

DISCUSSION

The increasing number of reports of non-traumatic RML is partly due to the increase in the incidence of its causes (which are mainly toxic, such as drug or alcohol abuse). It is also due to the introduction of serum CK determinations, as part of the labora-

Table 5. Laboratory data for patients: part 2

Case	Creatinine level (normal range, 0.7–1.5 mg/dl)			Blood urea nitrogen (normal range, 9–23 mg/dl)			Na^+ level (normal range, 137–151 mmol/l)	K^+ level (normal range, 3.8–5.3 mmol/l)	Ca^{2+} level (normal range, 8.5–10 mg/dl)		Phosphate level (normal range, 2.7–4.5 mg/dl)
	Admission	Peak	Discharge	Admission	Peak	Discharge			Start	Poliuric phase	
1	3.8	13 (4th day)	2.4 (18th day)	74	161 (5th day)	38 (18th day)	139	5.1	8.6	9.8 (10th day)	3.1
2	1.3	12.7 (7th day)	5.3 (20th day)	17	341 (normal <50) (8th day)	113 (normal <50) (18th day)	133 133	6.8 6.8	8.5 8.5	7.5 (15th day) 7.5 (15th day)	6.8 6.8
3	2.2	13 (6th day)	1.1 (33rd day)	25	108 (9th day)	13 (33rd day)	141	5.7	6.1	8.8 (33rd day)	7.75
4	0.8	0.9	0.7	18	18	8	151	4.5	8	–	3.4
5	1.4	1.4	0.8	11	11	10	137	4.3	8.1	–	3.4
6	4.1	12.8 (6th day)	1.7 (20th day)	36	250 (7th day)	87 (20th day)	135	7.1	7.5	9.2 (16th day)	4.5
7	18.5	18.5 <24 h	1.9 (22nd day)	183	318 (2nd day)	55 (22nd day)	140	7.2	8.4	10.8 (8th day)	7.25
8	1.8	1.8 <24 h	1.2 (2nd day)	23	23 <24 h	19 (2nd day)	139	4.6	8.5	–	2.4
9	1.2	1.2	0.7	11	15	15	138	4	8.5	–	3.1
10	2.5	2.5 <24 h	0.9 (3rd day)	68	68 <24 h	28 (3rd day)	140	4.5	8.5	–	2.1
11	0.9	0.6	0.7	11	4	12	138	3.9	9.4	–	3.1

*If not specified, time of sampling is 'upon hospital admission'

tory examinations routinely performed upon admission to an Emergency department, and which has resulted in improved diagnosis of this condition.

Nine of the 11 patients enrolled in the study presented with a toxic type of non-traumatic RML. The incidence of non-traumatic RML in patients with drug abuse was 40% during the study period. In addition, the other two types of non-traumatic RML observed during this study – prolonged muscular compression and seizures – have been reported frequently in the literature (Gabow *et al.*, 1982; Fernandez-Sola *et al.*, 1988; Fernandez-Funez *et al.*, 1995; Zele, 1999).

Table 6. Complications, therapy and length of hospital stay*

Case	Complications	Therapy	Hospital stay
1	ARF	I + A Dialysis (6 days)	18 days
2	ARF Compartmental syndrome	I + A Dialysis (7 days) Fasciotomy anterior/lateral and medial right leg area	80 days
3	ARF Compartmental syndrome	I + A Dialysis (21 days) Bilateral fasciotomy, following enlargement	65 days
4	Pulmonary oedema, Abortion	I + A	4 days
5	Interstitial pneumonia	I + A	3 days; leaves against physician's advice
6	ARF	I + A Dialysis (15 days)	20 days
7	ARF	I + A Dialysis (8 days)	26 days
8	Minor ARF Bronchopneumonia	I	7 days
9	NO	I	3 days
10	Minor ARF	I	7 days
11	NO	I	7 days

*A = alkalinisation using intravenous sodium bicarbonate (see text); ARF = acute renal failure; I = rehydration by intravenous infusion (see text)

In the patients enrolled in this study, the development of non-traumatic RML was found to be caused by many factors, including an altered level of consciousness (common to all patients in the study), muscular compression during prolonged abnormal body postures, and the induction of hypoxia and acidosis. In the two with non-toxic RML (case numbers 10 and 11), the chronic use of pharmaceutical drugs which can potentially induce RML (benzodiazepines in case 10; seizure control drugs in case 11) appeared to play a part in the development of the syndrome. Malnutrition hypophosphatemia was a contributory factor in case number 10. In the nine cases of toxic RML arising from the abuse of drugs, including amphetamines, benzodiazepines and non-steroidal anti-inflammatory drugs, heroin, cocaine, morphine, methadone and alcohol, the major factors causing the syndrome were accidental toxic agent inhalation and prolonged muscular compression. Fever, seizures, psychomotor agitation and electrolyte derangements also contributed to generating the syndrome. Muscular signs and symptoms, urinary signs, fever and/or eventually oliguria were typical of the clinical picture of the syndrome. These signs wre present, in accordance with literature (Gabow *et al.*, 1982; Hoijs *et al.*, 1999), in less than 50% of all patients. It should be noted that non-traumatic rhabdomyolysis often presents with no clinical symptoms of the condition.

In our survey, the presence of dark-brown urine was noted in one patient (case number 8), fever in two patients (case numbers 7 and 8), oliguria in five patients (case numbers 1, 2, 3, 6 and 7), and typical muscular signs in four patients. The incidence of typical muscular signs in four (36%) of patients differs from the incidence found in the published literature, which suggests that these signs are only found in up to 15% of patients in the early

stages of the syndrome. The major findings of typical muscular signs in our study is probably a result of the thorough assessment performed on patients who had regained consciousness and the accurate physical examination during the unconscious period. Indeed, the finding of a hardened, swollen muscular mass, even in the absence of skin colour changes should always raise the suspicion of RML or compartmental syndrome. It is important to note that, although myalgia and weakness are present in the early stages, are symmetrical and tend to regress slowly, painful myoedema is often non-symmetrical and involves mainly the upper and lower limbs (Gabow *et al*., 1982). The clinical symptom of muscular damage is often seen in toxic RML, secondary to the use of addictive drugs. The signs may be localised at the needle-stick injection site or may be a consequence of prolonged compression of muscular masses due to abnormal body postures during prolonged unconsciousness. This can be seen as the beginning as a vicious circle of ischaemia–oedema–ischaemia–necrosis resulting in a compartmental syndrome (Bagnoli *et al*., 1997).

The findings of dehydration, hypotension, and arterial blood gas determination of metabolic acidosis were the alerting signs of developing ARF in four of the seven patients with this complication (Woodrow *et al*., 1995). Of all the laboratory determinations, serum CK and myoglobin are considered to be essential and absolutely necessary for diagnosis. Rhabdomyolysis can be diagnosed if the serum CK value exceeds five times the normal value, the myoglobin fraction <5% and there is negative troponin I (William *et al*., 1989; Zele, 1999). Although serum CK values between 100 and 1,000 times the normal value are pathogenic, CK elevations in range of five to 20 times the normal value should be confirmed by elevated serum myoglobin values, as well as by GOT, GPT and LDH and, eventually, by the presence of myoglobin in urine (Grossman *et al*., 1974; Gabow *et al*., 1982; Bollaert *et al*., 1999). Peak levels obtained in the first 24–36 hours in our survey were consistent with the literature. In three patients, for whom serum myoglobin data was missing, serum CK values exceeded 100 times the normal values and were considered pathognomonic.

Characteristic but variable laboratory findings in RML are elevated serum uric acid, hyperkalaemia and hyperphosphataemia (Grossman *et al*., 1974; Gabow *et al*., 1982). Normal potassium and phosphate levels may indicate a primitive depletion of these electrolytes which are 'corrected' by the release of intracellular potassium and phosphates into the bloodstream release from necrotic muscle cells. In contrast, hypocalcaemia or near-to-low normal values are related to calcium storage in the necrotic muscle, and are characteristic and frequent findings in the early stages of the syndrome (Gabow *et al*., 1982; Hojs *et al*., 1999). In our survey, only one patient had normal serum calcium levels (case number 11). In the literature (Grossman *et al*., 1974; Gabow *et al*., 1982; Woodrow 1995), there are reports of late hypercalcaemia as a distinctive sign of RML, which can be found in 20–30% of patients with oligoanuric ARF at the beginning of the polyuric phase. In our study, this condition was found in one of the five cases of oligoanuric ARF.

The diagnosis of ARF relies on monitoring of serum creatinine, urea nitrogen and electrolyte levels. Laboratory findings predictive of an imminent ARF are hyperkalaemia (Bollaert *et al*., 1999) and arterial blood gas determination of metabolic acidosis.

Complications

During the course of the disease, many complications may occur, both local and systemic, sometimes involving different organs simultaneously. Acute renal failure is the most frequent and serious systemic complication because of its negative effect on electrolyte balance. Compartmental syndrome is the most severe local complication, because of the possibility of the development of ARF and permanent neuro-muscular injury. Other complications are cardiovascular failure, DIC and acute respiratory failure.

Nine of the 11 (80%) study patients had complications, even though the RML was diagnosed very early and therapy was begun rapidly. The most frequent complication was ARF which affected seven of 11 (63%) patients. As already discussed in the results, five of seven patients with toxic RML developed acute tubular necrosis with oligoanuria and needed urgent dialysis. Renal function had returned to normal values in only one of these patients at the time of hospital discharge. In two patients, one with toxic RML and the other with non-toxic RML, ARF was present in a mild form, with preserved diuresis and low serum creatinine levels. In these patients, rehydration therapy alone was sufficient to bring about full recovery of renal function.

Toxic RML complicated by ARF frequently occurs in its most severe manifestation (oligoanuria), when it has an unfavorable prognosis. The high incidence of this complication in our survey, compared with 20–30% reported in the literature (Grossman *et al*., 1974; Gabow, 1982; Fernandez-Funez *et al*., 1995), is probably due to the severity of illness and the predominance of toxic RML in patients in our study. Two of the five cases of oligoanuric ARF (case numbers 2 and 3) developed compartmental syndrome. Even with urgent fasciotomy, one of these patients developed a permanent neuropathy. Respiratory tract infections in cases number 5 and 8 resolved with antibiotic therapy. Endotracheal intubation was required for the patient with carbon monoxide poisoning and acute pulmonary oedema, who was admitted in a coma and with seizures.

Medical treatment

The medical therapy used was consistent with recommendations found in the literature (William *et al*., 1989; Zager 1996; Guglielminotti *et al*., 1999; Visweswaran *et al*., 1999).

- 7 days intravenous liquids and diuretics (furosemide) to promote renal blood flow.
- Making urine alkaline by the use of sodium bicarbonate boluses (1 mEq/kg every four hours, or any dose able to keep urine pH >6.5), which has the effect of limiting myoglobin precipitates in renal tubules.
- Dialysis therapy in cases of persistent oligoanuria with fluid overload, hyperkalaemia, metabolic acidosis refractory to treatment, uraemic pericarditis, or uraemic encephalitis.
- Decompressive fasciotomy and, eventually, hyperbaric oxygen therapy (Tibbles *et al*., 1996) in compartmental syndrome.

CONCLUSION

Non-traumatic RML is an uncommon syndrome with 17 cases found in 15,301 patients admitted to the Emergency department over the six-month study period. However, it is often found to complicate the clinical course of patients with an altered level of consciousness, being found in 11 of 32 patients admitted with an altered level of consciousness during the study period.

Non-traumatic RML may not always be clinically evident. Clinical signs were present in only five of 11 patients found to

have non-traumatic RML in our study. Thus, it is important that triage nurses search for characteristic signs (hardened muscles, with or without skin colour changes, myxoedema, reddish or dark-brown ['cola'-coloured] urine, oligoanuria, fever) and are prepared to take blood samples. Indeed, definitive diagnosis can be achieved through simple and rapid laboratory tests. Diuretics and volume replacement therapy should be started, even while waiting for laboratory results, to try and prevent the most severe complication of ARF, which was found in seven of the 11 cases in the study. Close monitoring of urine output is needed to detect early oligoanuria refractory to treatment, so that dialysis services can be alerted.

The finding of a swollen muscle following intravenous fluid therapy, especially in patients with drug addiction and an altered level of consciousness, must always raise the suspicion of a compartmental syndrome. In the case of the loss of peripheral pulses, early decompressive fasciotomy should promptly be performed.

Rhabdomyolysis, though uncommon, is potentially a very severe condition. If it is not detected quickly, the consequences can be extremely serious. Since an altered level of consciousness subsequent to acute drug and alcohol intoxication is often complicated by this syndrome, it has to be constantly kept in mind by Emergency department personnel. In addition, it is important to be aware that this condition may also develop in patients with seizures, elderly patients who have had prolonged muscular compression after loss of consciousness, and metabolic coma states (i.e. hyperosmolarity, ketoacidosis, myxoedema coma). Prompt detection allows therapy regimens to be started early, so helping to minimise the development of possible complications, improve prognosis and reduce the length of hospital stay.

We believe that the brief triage-selection sensitisation programme given to the nurses and physicians of the Emergency department prior to the study and the prospective study design have proved useful. We believe that they have increased the background knowledge of triage nurses and Emergency Department physicians and have led to improved quality of nursing and medical care for these patients.

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