The signs and symptoms seen in rhabdomyolysis were first noted in the 1940s. A team of researchers named the clinical picture as “crush syndrome.” Patients who were severely injured would recover from shock only to die from uremia a short time later. This syndrome was later recognized in military recruits undergoing basic training. The condition is not unknown within the prison population. A study by Senert, Kohl, Rainone, and Scalea (1994) reported on exercise-induced rhabdomyolysis in prison inmates from Rikers Island Prison who participated in hundreds of squat-thrusts as a result of losing a game of dominoes. Exertional rhabdomyolysis as seen in the correctional setting related to competitive exercising will be explored.

Causes of Rhabdomyolysis

Many causes of this syndrome have been cited. Rhabdomyolysis can be a result of an inherited or an acquired condition. If the metabolism of lipids and/or cholesterol is genetically altered, the syndrome can result as seen in McArdle’s disease. Muscular dystrophy can lead to this syndrome. Infectious processes that raise core body temperatures and effect muscle tissue including influenza, staphylococcus, HIV, and Epstein-Barr virus also have been noted to cause rhabdomyolysis (Sauret, Marinides, & Wang, 2002). Traumatic injury related to child abuse has been documented as a cause of this syndrome (Roy, Al Saleem, Al Ibrahim, & Al Hazmi, 1999). Drug-induced dehydration causing increased core body temperature, seen with psychiatric medication, put patients at risk for malignant neuroleptic syndrome which can include rhabdomyolysis (Mohr, Petti, & Mohr, 2003). Recently, drugs of abuse have been implicated as a causative factor after long hours of “rave” partying (Lee & Bania, 2000).

Pathophysiology

The definition of rhabdomyolysis is the liquefying of striated muscle cells (Beetham, 2000). Extreme exercise or injury to muscle tissue by any method begins a chain of effects that can lead to health and/or life-threatening consequences. The breakdown of the muscle tissue releases myoglobin into the extravascular spaces. Electrolyte imbalance causes the breakdown which produces high serum potassium and calcium levels and low sodium levels. These electrolyte imbalances can cause cardiac arrhythmia and arrest. Cascading effects include increasing levels of urates, creatines, phosphates, and myoglobin into the circulation. The kidney and liver attempt to filter these electrolytes and return the body to homeostasis. In doing this function, the kidney is damaged. It is thought that the kidney damage is the result of the myoglobin protein level forming casts. The casts obstruct the proximal tubules leading to acute renal failure (Beetham, 2000). The liver becomes inflamed as it performs its detoxifying function (Senert et al., 1994). Compartment syndrome further complicates this series of events. The large muscle groups located in the
Rhabdomyolysis Case Study

An inmate presented with complaints of bloody urine and severe back and leg pain. Other presenting symptoms were difficulty walking, standing straight, and urinating blood for the past few days. The inmate stated he had been doing squats a few days earlier as part of a competition.

Clinical Interaction

The inmate’s vital signs were within normal range. A first morning urine sample was collected for urinalysis and urine culture to rule out infection. Gross examination of urine noted a dark color. Urinalysis revealed high levels of protein and large amounts of blood. Specific gravity of the sample was low and the pH was in the acidic range. Urine culture was negative but myoglobin was identified in the sample. Blood samples were collected. Complete metabolic panel, complete blood count, creatinine level, and creatine kinase isoenzyme (CK) studies were ordered. Laboratory results showed extremely high levels of liver enzymes (ALT/GPT: 1126 IU/L; AST/GOT: 1721 [normal 10 to 40]), high levels of creatinine (13.2 mg/dL [normal 0.5 to 1.5]), and unobtainable CK levels due to interference. When laboratory results were verbally verified, the laboratory clarified the interference as values outside the quality control parameters, therefore unreportable. The inmate was ordered hospitalized and hemodialysis was instituted emergently. Hospital obtained laboratory CK levels were reported to be (49200 IU/L [normal 38 to 174]). Daily dialysis continued with limited success. Creatinine levels remained critically high.

Nursing care included monitoring of vital signs and renal output to provide the data needed to regain homeostasis. Support of the patient, based on lab data, can include administration of sodium bicarbonate to correct hyperkalemia and mannitol and/or furosemide to prevent water intoxication from aggressive fluid replacement treatment (Craig, 2002). Cardiac irritability, secondary to electrolyte changes, is followed by serial electrocardiograms. The close monitoring of the patient, usually in a critical care setting, will require intravenous access, urinary catheterization, cardiac rhythm analysis, and frequent administration of critical care medications (Criddle, 2003).

Two additional cases presented with similar signs and symptoms the following week. These inmates were housed on a different unit than the first case. After interrogation of Case #3, it was learned that an inmate coach had been teaching the inmates to do competitive squats using makeshift weights. A card game was involved regulating the number of squats the participants would perform. Case #2 reported doing 529 squats, and Case #3 reported doing 996 squats. The urine samples collected showed no new cases of extreme concern.

One urine sample had abnormal values of protein and blood, but was not considered at high risk. This inmate, Case #4, confessed to participating in the exercise activity and stated he did 100 squats. The inmate was counseled and ordered to increase hydration and rest. Blood samples were drawn from this inmate for further evaluation of his health status. Resulting laboratory findings showed increased CK levels. Case #4 was hospitalized for further treatment.

Results of Clinical Interaction

The correctional setting in which the noted cases were diagnosed is a detention center where the inmates are housed for a short term while undergoing legal proceedings. This short-term stay limits the ability to study the long-term effects these cases endured. All cases described were successfully returned to homeostasis being independent and not requiring dialysis after discharge from the hospital.

Clinical Implications

As a result of this initial presenting case and three subsequent cases, inmate education was offered via town hall forum. A memorandum was sent to all staff regarding strenuous exercise hazards and the overexercise activity was ordered to stop immediately. Opportunity to submit urine samples for evaluation was given to any concerned inmate.

Conclusion

At this institution, awareness of unsafe exercise practices was promoted through education of both staff and inmate populations. Continued contact with the identified at-risk group appeared to quell the trend of unsupervised competitive exercise that led to this dangerous syndrome.

Signs and Symptoms

Dark tea-colored urine is the hallmark sign of rhabdomyolysis (Kuklo, Tis, Moores, & Schaefer, 2000; Sauret et al., 2002; Senert et al., 1994). This can be mistaken for bloody urine and will show as high levels of blood on urine dipstick testing. Further microanalysis of the urine sample will show no blood cells (Puppa, 1995). This occurs because the closely related hemoproteins of hemoglobin and myoglobin are not distinguishable by dipstick testing (Beetham, 2000). Other signs and symptoms that may be considered are complaints of muscle soreness, cardiac arrhythmias, and confusion. Large areas of ecchymosis can be seen (Roy et al., 1999). Swelling of large muscle groups might be noted. These signs should be considered as possibly associated with rhabdomyolysis if presented with a
history of overexercise. Vital signs may show increase in temperature and low blood pressure due to hypovolemia (Sauret et al., 2002). Laboratory results show high serum creatine kinase isoenzymes, creatinine, liver enzymes, and bilirubin. Urinalysis shows low pH, large blood and high protein levels (Senert et al., 1994).

**Nursing Implications**

The varied causes of this syndrome require that nurses in many fields should recognize the signs and symptoms of rhabdomyolysis. Whether the nurse is working in the emergency room, psychiatric setting, or the correctional setting, this potentially fatal syndrome must be considered when muscle damage is suspected. The hallmark symptom of tea-colored urine should alert the nurse for further investigation. This investigation should include extensive history taking to assess the medication profile, activity level, genetic background, and any acute trauma experienced by the patient.

**Considerations in the Correctional Setting**

The responsibility to provide for the safety of the inmate population should be included in the mission statement of all prison facilities. Protecting this population from harming themselves by participating in overexercise can be done with the involvement of all departments in corrections. Recreational staff can educate inmates in safe exercise practices. Custody staff can be aware of unsponsored physical competitions. Medical staff can be alert to any of the presenting signs and symptoms and respond appropriately. All staff can monitor for any makeshift weightlifting equipment. Education of both inmate population and staff as to the importance of recognizing unsafe exercise behavior is paramount. Additionally, communicating knowledge of this activity expediently to supervisory staff can prevent future cases of this sometimes-fatal syndrome of rhabdomyolysis.

**References**


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