Rhabdomyolysis After the Use of Percussion Massage Gun: A Case Report

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Abstract

Objective. Percussion massage guns are commonly used by professional athletes and nonathletes worldwide for warm-up and physical recovery; however, there are no published clinical or evidence-based reports on percussion guns regarding their benefits, indications, contraindications, and even side effects. The purpose of this case report is to describe the first case of rhabdomyolysis as a severe and potentially life-threatening illness following use of a percussion gun.

Methods. A young Chinese woman with untreated iron deficiency anemia presented with fatigue and pain in her thigh muscles for 3 days and tea-colored urine for 1 day, after cycling and subsequently receiving percussion gun treatment by her coach for the purpose of massage and relaxing tired muscles. Muscle tenderness and multiple hematomas were found on her thighs, and her urinalysis indicated hemoglobinuria. Her serum creatine kinase was reported as “undetectably high,” a hallmark of serious muscle damage leading to a diagnosis of severe rhabdomyolysis. Aggressive intravenous fluid resuscitation, urine alkalinization via intravenous alkaline solution, assessment of urine output, and maintenance of electrolyte balance were administered during hospitalization.

Results. The patient’s clinical presentation gradually improved with the decline of creatine kinase, and she recovered well during follow-up.

Conclusion. A case of severe rhabdomyolysis after percussion massage should alert caregivers, sports professionals, and the public to suspect and recognize the potentially serious adverse effects of percussion guns and to ensure that percussion massage guns be used appropriately and safely in rehabilitation therapy, especially in individuals with an underlying disease or condition. Research is needed to examine the benefits, indications, contraindications, and adverse reactions of percussion guns.

Keywords: Rhabdomyolysis, Percussive Therapy, Percussion Massage Gun, Trauma, Case Report
Introduction

Percussion massage guns are popular devices used by professional athletes and nonathletes worldwide for percussive massage or percussive therapy (ie, neuromuscular vibration therapy). Their manufacturers claim that these devices can send rapid, strong, and short-term pulsating strokes deep into muscle tissues, similar to a small jackhammer. In doing so, they are claimed to help stretch muscles and connective tissues, reduce soft tissue pain, improve blood circulation to the affected area, and enhance recovery and overall physical performance. However, the medical literature contains no clinical/evidence-based reports regarding the benefits, indications, contraindications, and side effects of these devices. Herein, we report a case of rhabdomyolysis after the use of percussion gun.

Rhabdomyolysis is a serious and potentially life-threatening syndrome attributable to the breakdown of damaged skeletal muscle fibers and the release of their contents, especially myoglobin, potassium, and proteases, into the bloodstream. The primary symptoms of rhabdomyolysis can be nonspecific, including muscle weakness, soreness, bruising, fatigue, tea-colored urine, low urine output, nausea, vomiting, fever, confusion, and agitation. Tea-colored urine is generally an early sign suggestive of this condition. The usual investigations for rhabdomyolysis include serum creatine kinase (CK), serum potassium, serum creatinine, and myoglobin in blood and urine. Acute kidney damage, cardiac arrest, hepatic failure, and even death are the major/dangerous consequences of rhabdomyolysis, and the long-term prognosis depends on the degree of kidney damage.

Methods

On July 3, 2019, a 25-year-old Chinese woman with untreated mild iron deficiency anemia (baseline hemoglobin: 103 g/L; normal range: 115–150 g/L) presented at the Outpatient Department, Shantou Longhu People’s Hospital, Shantou, Guangdong, China, with significant fatigue and pain in her thigh muscles for 3 days, affecting her ambulation and associated with a 1-day history of tea-colored urine. Two and 3 days previously, she had cycled in a gym intermittently at an intensity of 6 to 7 mph for approximately 30 minutes each day. Right after cycling, she received percussive massage over her bilateral thighs for nearly 10 minutes through a commercial percussion gun for the purpose of massage and relaxing tired muscles. This treatment was provided by her coach, who did not take a medical history of the patient before the treatment and gave the treatment without supervision by qualified health care professionals. The patient developed pain in her bilateral thighs that evening, and urine discoloration was noticed 2 days later. She reported a previous tendency to bruise, even with minor trauma, but otherwise she had been generally healthy, with no family history of relevant disease or psychosocial concerns. She did not report any prodromal or aggravating events.

On examination, her vital signs were normal. She demonstrated significant muscle tenderness and multiple hematomas (scattered gunshot-like bleeding spots and merged bruises) over her thighs. Her urine was turbid and dark brown, and the urinalysis showed significant hemoglobinuria, suggestive of destruction or lysis of red blood cells. The urinalysis was otherwise negative, with no evidence of infection. Her CK was reported as “undetectably high,” a predominant sign of serious muscle damage. She was diagnosed with severe rhabdomyolysis and admitted immediately to the hospital. Aggressive intravenous fluid resuscitation, urine alkalinization via intravenous alkaline solution, assessment of urine output, and maintenance of electrolyte balance were administered during hospitalization.

Outcomes

After 1 day in the hospital, her urine turned clear. Throughout her hospitalization, her electrolyte balance (eg, serum sodium, potassium, and phosphorus), renal function (eg, blood urea nitrogen and serum creatinine), and coagulation function (ie, prothrombin time, international normalized ratio, fibrinogen, thrombin time, and activated partial thromboplastin time) all remained normal (Tab. 1). Her CK sharply decreased from more than 30,000 U/L to 301 U/L (normal range: 24–195 U/L) over the following 2 weeks of her hospital stay (Tab. 1); as this decreased, her clinical presentation gradually improved. Other nonspecific serum markers for muscle and liver damage also steadily decreased prior to discharge (July 17, 2019) (Tab. 1). At follow-up on September 2, 2019, she had recovered well without apparent adverse or unanticipated events (including no recurrence of bruising), although her iron deficiency anemia and minor hepatocellular jaundice persisted (Tab. 1). During a follow-up phone call on May 28, 2020, she stated that she had remained healthy other than still taking iron supplements for iron deficiency anemia.

The patient was satisfied with her treatment and outcome and gave written informed consent for this report, which complied with the Declaration of Helsinki and was reviewed and approved as well by the Ethics Committee of Shantou Longhu People’s Hospital, Shantou, Guangdong, China.

Discussion

Rhabdomyolysis is a rare but severe and occasionally lethal disease. About 26,000 cases of rhabdomyolysis have been reported in the United States annually; the overall incidence of rhabdomyolysis in Korean inpatients was 0.06% from 2006 to 2011. The prevalence/incidence of rhabdomyolysis in China is uncertain. As demonstrated in this case, patients commonly present with weakness, myalgias, and bruising; laboratory findings include an elevated serum myoglobin, a urinalysis strongly positive for blood but rare red blood cells (ie, hemoglobinuria), and dramatically increased serum CK.

There can be various physiologic responses to tissue damage and bleeding for rhabdomyolysis, including local subsequent scar tissue and calcific deposit formation, in addition to more severe systemic responses. Various complications of rhabdomyolysis can occur and are categorized as early or late. Severe hyperkalemia due to the release of potassium from destroyed muscle fibers into the bloodstream is one of the early complications, potentially leading to cardiac arrhythmia and arrest. Acute renal failure caused by excessive myoglobin and other contents leaking from breakdown muscles into the bloodstream is the most severe late complication, occurring in about 15% of patients with rhabdomyolysis. A serum CK level of higher than 16,000 U/L is associated with a higher likelihood of acute renal failure. The proteases released from necrotic muscles may induce hepatic inflammation, as the elevations of alanine aminotransferase (mostly found in liver) and aspartate aminotransferase (found in liver and other organs) can be seen in 75% and 93% of rhabdomyolysis cases,
### Table 1. Laboratory Results Before, During, and After Hospitalization (July 3, 2019–September 2, 2019)

| Variable | Result on Day After Onset | Reference Range |
|----------|---------------------------|-----------------|
| **Urinalysis** |                           |                 |
| Blood | 4+ 3+ 3+ 3+ 3+ 3+ 3+ | Neg 3+ 3+ 3+ 3+ 3+ 3+ 3+ |
| Leukocyte | 0 0 0 0 0 0 0 | Neg 3+ 3+ 3+ 3+ 3+ 3+ 3+ |
| Red blood cell microscopy | 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 |
| White blood cell microscopy | 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 |
| **Blood (routine)** |                           |                 |
| Red blood cell count | 4.41 4.02 4.56 4.47 4.24 4.50 4.50 | 3.8 × 10^12–5.1 × 10^12/L |
| Hemoglobin | 111 103 115 108 100 96 96 | 115–150 g/L |
| Hematocrit | 0.34 0.31 0.34 0.33 0.31 0.30 0.30 | 0.35–0.45 |
| Mean corpuscular volume | 76.6 77.1 74.8 73.6 73.6 73.6 73.6 | 82–100 fL |
| Mean corpuscular hemoglobin | 25.2 25.6 25.2 24.2 24.1 23.4 23.4 | 24–27 pg |
| Mean corpuscular hemoglobin concentration | 328 332 327 328 327 327 327 | 318–354 g/L |
| **Biochemistry (serum)** |                           |                 |
| Blood urea nitrogen | 4.02 3.26 3.2 3.68 3.55 3.55 3.55 | 2.5–7.14 mmol/L |
| Creatinine | 53 52 53.9 49.6 58.8 58.8 58.8 | 64–133 mmol/L |
| Glucose | 5.43 4.68 6.92 4.41 4.6 4.6 | 4.97–6.11 mmol/L |
| Sodium | 142.8 139 140 137 137 137 137 | 137–147 mmol/L |
| Potassium | 4.11 3.8 3.75 3.55 3.79 3.79 3.79 | 3.5–5.3 mmol/L |
| Phosphorus | 1.18 1.18 1.34 1.34 1.34 1.34 1.34 | 0.8–1.65 mmol/L |
| Alanine aminotransferase | 395.2 372.4 344 201 81 77 77 | 108–407 U/L |
| Aspartate aminotransferase | 1042/1190\(^\text{a}\) 876.89 767.89 627 529 22 22 | 13–35 U/L |
| Creatine kinase | +∞ 32,290 24,502 4241 515 301 108 | 24–195 U/L |
| Creatine kinase MB fraction | 880 244 125 95 86 70 70 | 0–25 U/L |
| α-Oxybutyrase | 1549 1328 1135 798 373 254 96 | 93–250 U/L |
| Lactate dehydrogenase | 2307 1852 1713 1130 552 359 146 | 100–245 U/L |
| Lactate dehydrogenase isoenzyme 1 | 234 203.9 178 98 73 27.1 27.1 | 15–65 U/L |
| Myoglobin | 304.8 210.1 178 98 73 27.1 27.1 | 25–75 ng/mL |
| Lactic acid | 1.21 1.21 1.21 1.21 1.21 1.21 1.21 | <2.4 mmol/L |
| Total bilirubin | 19.53 22 17.7 16.4 11 7 7 | 22.04 1.7–20 μmol/L |
| Direct bilirubin | 6.98 7.62 3.8 3.1 2.2 1.1 1.1 | 7.99 0–6.8 μmol/L |
| Indirect bilirubin | 12.55 14.38 13.9 13.3 8.8 14.05 14.05 | 1.7–13.2 μmol/L |
| Total protein | 71.35 58.55 69.64 62.8 65.1 68.96 68.96 | 65–85 g/L |
| Albumin | 48.1 40.36 37.54 35.8 39.1 47.76 47.76 | 40–55 g/L |
| Globulin | 23.25 18.19 31.98 27 26 22.2 22.2 | 20–40 g/L |
| Folic acid | 14.53 14.53 14.53 14.53 14.53 14.53 14.53 | 3.89–6.8 ng/mL |
| Vitamin B\(_{12}\) | 428.22 428.22 428.22 428.22 428.22 428.22 428.22 | 180–916 μg/mL |
| Ferritin | 4.8 4.8 4.8 4.8 4.8 4.8 4.8 | 12–135 ng/mL |
| Iron | 3.9 3.9 3.9 3.9 3.9 3.9 3.9 | 9–30 μg/mL |

\(^{a}\)Abnormal values are shown in bold type. MB = myocardial band; Neg = negative; +∞ = undetectably high. Interpretations were as follows. The urinalysis showed blood at 3+ but 0–8 red blood cells per high-power field, suggesting apparent gross hematuria but rare microscopic hematuria (ie, hemoglobinuria because of the destruction or lysis of red blood cells); raised elevated serum alanine aminotransferase and aspartate aminotransferase normally indicate liver damage or disease(s), acute myocardial infarction, skeletal muscle damage, intoxication, or infection(s); elevated serum myocardial enzymes (ie, creatine kinase, creatine kinase MB fraction, α-oxybutyrase, lactate dehydrogenase, and lactate dehydrogenase isoenzyme 1) generally suggest acute myocardial infarction, skeletal muscle damage, or liver disease(s); elevated serum myoglobin usually reveals acute myocardial infarction, skeletal muscle damage, renal failure, or trauma; decreased blood hemoglobin, hematocrit, mean corpuscular volume, mean corpuscular hemoglobin, and serum ferritin and iron support a diagnosis of iron deficiency anemia; and simultaneously elevated total bilirubin, direct bilirubin, and indirect bilirubin indicate minor hepatocellular jaundice. \(^{b}\)The day of the clinic visit (July 3, 2019). \(^{c}\)The day of admission (July 4, 2019). \(^{d}\)Follow-up after discharge (September 2, 2019). \(^{e}\)Aspartate aminotransferase: 1042 U/L in the morning and 1190 U/L in the afternoon on day 4 after onset (July 4, 2019).
rhabdomyolysis. In China, common causes of rhabdomyolysis include trauma, wasp stings, and consumption of crayfish, medications, or traditional Chinese medicine. In this case, many varied causes/risk factors of rhabdomyolysis have been ruled out, such as heat stroke, alcoholism, eating crayfish, intake of medications (including traditional Chinese medicine/supplements/illicit drugs/toxic substances, insect/snake bites, antecedent infections, diabetes mellitus (no medical history of diabetes and nearly normal serum glucose during hospitalization) (Tab. 1), thyroid diseases (normal thyroid-stimulating hormone, free triiodothyronine, and free thyroxine) (Tab. 2), polymyositis (normal immunological test results) (Tab. 2), dermatomyositis (normal immunological test results) (Tab. 2), capillary leak syndrome (normal blood pressure and no shock, edema, or intravascular hypovolemia in our patient), thalassemia (normal thalassemia genetic test results) (Tab. 2), and sickle cell disease (rare in people of Chinese descent and unsupported by the hemoglobin electrophoresis results shown in Tab. 2).

In conclusion, we highlight a fascinating case of rhabdomyolysis after the use of a percussion gun. As percussion guns become increasingly popular worldwide, it is imperative to evaluate their safety and educate sports professionals and the public of their proper use, encompassing their indications and contraindications, including the latent risk of developing potentially fatal complications such as rhabdomyolysis. To the best of our knowledge, this is the first report of rhabdomyolysis after the use of a percussion gun. It is important for caregivers, sports professionals, and the public to consider and recognize the potentially serious adverse effects of this commonly used device and to emphasize that it be used appropriately and safely in rehabilitation therapy, especially in white male with chronic malabsorption, severe iron deficiency anemia, and selective immunoglobulin A deficiency. Free iron within iron-dextran (unused in our patient) was the suggestive cause of rhabdomyolysis in that case. Therefore, whether iron deficiency anemia is truly linked to rhabdomyolysis remains uncertain. An underlying condition of anemia (eg, thalassemia), or other factors frequently seen in athletes (eg, dehydration) might increase the risk of a systemic response of rhabdomyolysis.

Trauma is highly suspected to be the dominant cause of rhabdomyolysis based on the medical history and clinical features of our patient. Cycling for half an hour per day on 2 days would not be considered as overexertion in this patient, as she had previously cycled and had not developed rhabdomyolysis before. However, the repeated beats of the percussion gun in the affected muscles after exercising could destroy muscle fibers and thus lead to rhabdomyolysis, producing pain and hematomas in her thighs. Unfortunately, it is unknown whether her coach as a nonmedical professional had used the percussion gun according to product instructions and whether these instructions have been validated clinically and scientifically.

Table 2. Additional Laboratory Results

| Variable | On Presentation | Reference Range |
|----------|----------------|-----------------|
| Hemoglobin electrophoresis | | |
| Adult hemoglobin | 0.976 | 0.945–0.975 |
| Fetal hemoglobin | 0 | 0–0.025 |
| Hemoglobin A2 | 0.024 | 0.025–0.035 |
| Genetic test | | |
| α-Thalassemia gene (deletion mutation) | αα/αα | αα/αα |
| α-Thalassemia gene (point mutation) | αα/αα | αα/αα |
| β-Thalassemia gene | N/N | N/N |
| Immunological test (antibodies) | | |
| Anti-U1RNP/Sm | Negative | Negative |
| Sm | Negative | Negative |
| SS-A | Negative | Negative |
| SS-B | Negative | Negative |
| Scl-70 | Negative | Negative |
| Jo-1 | Negative | Negative |
| Antiribosomal phosphoprotein | Negative | Negative |
| Ro-52 | Negative | Negative |
| Centromere protein B | Negative | Negative |
| Double-stranded DNA | Negative | Negative |
| Antinucleosome antibodies | Negative | Negative |
| Antihistone antibodies | Negative | Negative |
| Hemoglobin A2 | 0.024 | 0.025–0.035 |
| Fetal hemoglobin | 0 | 0–0.025 |

a-Anti-U1RNP/Sm = ribonucleoprotein antibodies/Smith antibodies; dsDNA = anti-double stranded DNA antibody; Jo-1 = histidyl tRNA synthetase antibodies; N/N = normal/normal; Ro-52 = anti-Ro52 antibody; Scl-70 = topoisomerase 1 antibodies for scleroderma (systemic sclerosis) testing; SS-A = Sjogren syndrome A antibodies; SS-B = Sjogren syndrome B antibodies.
individuals with underlying disease(s) or condition(s). Further investigations are needed to examine the benefits, indications, and contraindications of and adverse reactions to percussion guns.

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Ethics Approval
The Ethics Committee of Shantou Longhu People's Hospital, Shantou, Guangdong, China, reviewed and approved this study. This study complied with the Declaration of Helsinki, and the patient gave written informed consent.

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Disclosure
The authors completed the ICMJE Form for Disclosure of Potential Conflicts of Interest and reported no conflicts of interest.

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