ISSN 2692-5877
DOI: 10.46998/IJCMCR.2024.44.001091

International Journal of
Clinical Studies & Medical Case Reports

Review Article

Muscle Spasm: A Primer

Michelle J Lespasio*

Nurse Practitioner and Assistant Professor, Department of Orthopaedic Surgery, Boston Medical Center, USA

***Corresponding authors:** Michelle J Lespasio, DNP, JD, NP, Nurse Practitioner and Assistant Professor, Department of Orthopaedic Surgery, Boston Medical Center, Boston, MA, USA

Received: August 23, 2024 **Published:** October 25, 2024

Abstract

The primary purpose of this article is to report the latest medical research available on muscle spasm in the adult population. In addition, this review will discuss, (a) causes, (b) associated risk factors, (c) prevalence, (d) clinical significance, (e) pathogenesis, (f) relevant studies, and (g) management. A six-item true or false quiz in the beginning of the article serves as a primer to orient the readers with their understanding of the material.

Keywords: Muscle spasm; Muscle cramps; Nocturnal muscle spasm; Nocturnal muscle cramps; Nocturnal leg camps
Abbreviations: NMC-Nocturnal Muscle Cramps; LABA-Long-Acting Beta Agonists; LE-Lower Extremities; CHF-Congestive Heart Failure; ALS-Amyotrophic Lateral Sclerosis; LSS-Lumbar Spinal Stenosis; SASE-Statin-Associated Side Effects; NLC-Nocturnal Leg Cramps; DM-Diabetes Mellitus; MOMH-Magnesium Oxide Monohydrate; CPK-Creatine Phosphokinase; US-United States; PE-Physical Examination; OTC-Over-The-Counter; CT-Computerized Tomography scan; MRI-Magnetic Resonance Imaging; US-Ultrasound; FDA-Federal Drug Administration

Introduction

The article begins with the following Advance Organizer Quiz to Retrieve, Use, and Organize the Materials presented in this paper.

Advance organizer – please answer true or false to the following questions:

1. Most etiologies of muscle spasm are clear and well-defined. False
2. True muscle spasms are visible contractions in a weakened muscle or part of a muscle. True
3. A causal connection between muscle spasm and hepatic cirrhosis has been described. True
4. Various therapeutic interventions are established to have an impact on leg cramps in patients with lumbar spine stenosis. False; unknown
5. Risk factors and symptoms associated with muscle spasm are generally anecdotal. True
6. Deficiency of choline may induce muscle cramps. True

Muscle spasm

A muscle spasm is described as a sudden tightening or involuntary contraction within a skeletal muscle that is unable to relax [7]. Most muscle spasms occur in the calves and feet, are often referred to as leg cramps and are acute painful [1]. True muscle spasms are visible, palpable painful contractions in a weakened muscle or part of a muscle [2]. The main cause for the symptom of pain in muscle spasm is due to ischemia of the muscle [3]. Muscle spasms can last for seconds to several minutes and may result in paralysis-like immobility, persistent tenderness and swelling for up to 72 hours following the episode of cramping [2]. Reported episodes of prolonged muscle cramps that persist for over 8 hours are referred to as a phenomenon called cramp prone state [4].

Some causes of leg cramps are attributed to acute fluid loss and electrolyte imbalance associated with repetitive physical activity of the lower extremities (LE) [5]. True muscle cramps by definition, however, occur in the absence of fluid or electrolyte imbalance and are affiliated with diverse etiologies [6]. Other causes appear to involve sustained abnormal spinal reflex activity secondary to fatigue of the affected muscles [5] **(Table 1)**.

Leg cramps may also be a sign of other serious underlying medical conditions, including motor neuron (specialized cells in brain and spine) disorders, cardiac (heart) conditions and metabolic (alteration in macronutrients) disorders [7]. In addition, muscle spasm presenting as cramping or aching in the calves, is the most common symptom of lumbar spinal stenosis (LSS) [8,9]. Muscle spasms that occur during the night are called nocturnal muscle cramps (NMC) (also commonly described as rest cramps) [1].

DOI: 10.46998/IJCMCR.2024.44.001091

Common Causes of Muscle Spasm

(1) Repetitive physical activity of lower extremities

While an exact cause of muscle spasm (or cramping) remains unclear, common episodes of muscle spasm frequently occur with repetitive activity or stress of the LE at any time during exercise when the muscle is tired or fatigued [1]. It is suggested that during physical activity, individuals are predisposed to acute water loss leading to hypovolemia (e.g., acute fluid and electrolyte imbalance) and dehydration (i.e., loss of water or not getting enough water) thereby increasing one's risk of developing muscle spasm [10]. Interestingly, the mechanisms behind various types of muscle cramps involved in different types of physical activity is not known. As explained by Maughan et al.,5 the highly localized cramp in the calf that afflicts a soccer play late in the game in very different from the whole-body cramps described by American football players and tennis players, which are different from the cramp that afflicts small muscles used in repetitive exercise such as the hand in writers or typists **(Table 1)**.

Table 1: Common causes/risk factors of muscle spasm.

1. Repetitive physical activity on a muscle or muscle group
2. Hypovolemia or acute extracellular volume depletion/fluid imbalance
3. Electrolyte imbalance
4. Dehydration
5. Medications
6. Serious underlying medical conditions **(Table 3)**

(2) Acute Fluid Loss and electrolyte imbalance

The problem of hypovolemia

Maintaining a specific fluid balance of electrolytes is called euvolemia and is essential for cells to work normally [11]. Hypovolemia, in contrast, is a process in which too much water and sodium (salt) is depleted in the human body leading to an electrolyte imbalance [12]. Symptoms of hypovolemia may include fatigue, thirst, muscle cramps, dry mouth, changes in skin tone (loss of elasticity), dizziness when standing (orthostatic vertigo) and urinating less than usual [13]. Severe hypovolemia may cause abdominal pain, chest pain and confusion [13] **(Table 2)**. Loss of fluid through vomiting, diarrhea or heavy sweating can lead to electrolyte imbalance due to hypovolemia.

The problem of dehydration

Dehydration refers to loss of water only or not getting enough water to maintain the body's balance of sodium [12]. Any medical condition that causes diuresis (or a person to perspire or urinate more than usual) can lead to hypovolemia and dehydration [16]. Hemodialysis, diarrhea and diuretic therapy (substance used to promote excretion of water) can lead to volume depletion and dehydration [17]. Similarly, not drinking enough water to make up for normal amounts of water lost normally can lead to dehydration.

Table 2: Symptoms of hypovolemia.

1. Fatigue
2. Thirst
3. Muscle cramps
4. Dry mouth
5. Loss of skin tone or elasticity
6. Orthostatic vertigo
7. Decreased urination
8. Abdominal pain
9. Chest pain
10. Confusion

Medications

There are many medications that are known to have an association with muscle spasm. These may include diuretics, beta-blockers, cholesterol-lowering statins, bronchodilators, neuroleptics, tolcapone, nifedipine, terbutaline, albuterol, isotretinoin, zolpidem [1]. Others known to be related to nocturnal muscle spasm include long-acting beta agonists (LABA), diuretics (thiazide/potassium sparing diuretics), loop diuretics and cholesterol-lowering statins [1].

(3) Underlying medical conditions associated with muscle spasm (Table 3)

(A) Amyotrophic lateral sclerosis (ALS), commonly known as Lou Gehrig's disease, is a progressive neuromuscular and degenerative disorder that causes muscle weakness, disability and eventual death [18]. The clinical hallmark of ALS is the combination of upper and lower motor neuron signs and symptoms [18]. Common symptoms in this condition include muscle weakness (reduced muscle strength), atrophy (wasting of muscle cells) and fasiculations (involuntary visible muscle twitching) [18,19]. Muscle cramps in ALS are a common manifestation of loss of lower motor neurons [19].

(B) Congestive heart failure (CHF) is a cardiac condition in which the heart pump inefficiently contracts or pumps blood in its effort to provide a normal supply within the body. Consequently, because heart failure results in poor blood flow, inadequate circulation and impaired oxygenation, muscle cramps can occur in the lower extremities [20]. Leg cramps that persist despite inactivity or that are frequently present with ambulation or exercise can be an early sign of heart failure.21 Currently, the role of altered skeletal muscles during CHF and the influence of intracellular changes of metabolism in the myocardium remains the subject of ongoing investigation [20].

(C) Hepatic (liver) cirrhosis represents a late stage of progressive liver fibrosis characterized by scarring and the formation of regenerative nodules [22]. In advanced stages, cirrhosis is generally considered to be irreversible. In earlier stages, specific treatments aimed at the underlying cause of liver disease may improve or even reverse cirrhosis [22]. It is estimated that up to 88% of patients with hepatic cirrhosis experience painful muscle cramps resulting in sleep deprivation and impaired quality of life. Muscle cramps in liver disease generally affect the hands, legs and feet but may also affect the neck, back and sides [23]. The etiology of muscle cramps in patients with liver disease is still largely unknown.24 Management is often based on poor evidence with varying degrees of success in controlling the frequency and severity of muscle cramps in this group [24].

(D) Lumbar spinal stenosis (LSS) is an anatomic condition that results in narrowing of the intraspinal (central) canal, lateral recess, and/or neural foramen [8]. As a major clinical problem, LSS is commonly seen in individuals over 60 years old [25]. This spinal disorder may cause compression of the spinal nerves leading to neurophysiologic dysfunction, degeneration and reduced blood flow in nerve roots [26].

Commonly associated symptoms in LSS include intermittent claudication, pain, numbness and decreased sensation. The

most common symptom of spinal stenosis, however, is cramping or aching in the calves [27]. As this spine condition advances, it becomes increasingly difficult for individuals to stand and walk due to the intensity of the resulting leg pain (and muscle spasm). At this time, there is limited information available in the medical literature on the relationship between muscle spasm and LSS, and there is a scarcity of research available on the impact of nonsurgical or surgical interventions on leg cramps in patients with LSS [25].
(E)

Table 3: Serious underlying medical conditions associated with muscle spasm.

(1) Motor neuron disorder: Amyotrophic lateral sclerosis (ALS)/Lou Gehrig's disease
(2) Cardiac disorder: Congestive heart failure (CHF)
(3) Metabolic disorder: Hepatic cirrhosis
(4) Musculoskeletal disorder: Lumbar spinal stenosis (LSS)

Nocturnal Muscle Cramps (NMC)

NMC and other sleep-related leg cramps are a common lower extremity condition that produces significant pain leading to disruption of sleep **(Table 10)**. The differential diagnosis of nighttime leg discomfort includes, (a) restless leg syndrome, (b) periodic limb movements and (c) muscle cramps associated with pregnancy (2nd and 3rd trimester).38, 39 In addition, (d) various medications have been associated with nighttime muscle cramps **(Table 4)**.

NMC are common and frequently go unreported to clinicians thereby contributing to the anecdotal nature [28]. Symptoms result from involuntary muscle contractions, which are sudden in onset, usually affect the calf or foot [1]. Conditions related to leg symptoms with nocturnal muscle cramps include, (a) hypertension (HTN), (b) peripheral vascular disease (PVD), (c) coronary artery disease (CAD), (d) cerebrovascular disease (CVD), (e) kidney disease and (f) hypokalemia [30].

In particular, nerve root compression and PVD are believed to be predisposing factors for nocturnal leg cramps [31]. Frequently observed in patients with peripheral neuropathy (damage to nerves connecting the brain and spinal cord to the rest of the body), there is prevalence of nocturnal leg cramps (NLC) associated with lumbar spine stenosis (LSS) and severity of symptoms [26] **(Table 5)**.

Table 4: Differential diagnosis of nighttime leg discomfort.

1. Restless leg syndrome
2. Periodic limp movements
3. Muscle spasm/cramps associated with pregnancy
4. Medication-related muscle spasm

Table 5: Common causes of nocturnal muscle cramps.

1. Underlying serious medical conditions
2. Peripheral neuropathy
3. Lumbar spine stenosis
4. Hypertension
5. Peripheral vascular disease
6. Coronary artery disease
7. Cerebrovascular disease
8. Kidney disease
9. Hypokalemia

Table 6: Medications associated with increased risk of nocturnal muscle cramps

1. Long-acting beta agonists (LABA)
2. Diuretics (thiazide/potassium sparing diuretics)
3. Loop diuretics
4. Cholesterol-lowering statins

Associated risk factors for nocturnal muscle spasm

Risk factors and conditions are anecdotal and may be coincidental given high prevalence of the symptoms, particularly in those with medical comorbidities [1] (Tables 7-9) Thus, the majority of patients with leg cramps have no definitively known underlying cause. Clinical features of nocturnal muscle spasm are identified in **Table 10**.

Activities that are associated with repetitive lower extremity stress of the muscles of the lower extremities are associated with increased risk of nocturnal muscle cramps [1]. Examples include prolonged sitting, positioning that place prolonged pressure on the leg and walking or running on concrete floors [1].

Medications associated with increased risk of nocturnal muscle cramps include Long-Acting Beta Agonists (LABA), diuretics (thiazide/potassium sparing diuretics, loop diuretics and statins [32] **(Table 6)**. Statin-Associated Side Effects (SASE) are rare in clinical trials making a causal relationship with statins unclear [33]. They are important, however, because the muscle cramps associated with statins may trigger dose reduction, change in medication dose or discontinuation altogether of these life-saving agents [33].

Table 7: General risk factors associated with muscle spasm.

1. Repetitive activities that stress muscles of lower extremities
2. Medications
3. Secondary nocturnal cramps
4. Exercise associated muscle cramps
5. Radiculopathy
5. Cardiac disease
6. Other medical conditions **(Table 9)**

Table 8: Secondary nocturnal cramps

1. Sleep disorders (e.g., restless leg syndrome, periodic limb movements of sleep, obstructive sleep apnea)
2. Peripheral vascular disease (PVD)
3. Fluid imbalance
4. Pregnancy
5. Metabolic disorders (diabetes type II, hypoglycemia, hypocalcemia, alcoholism, hypothyroidism)
6. Neurologic disorders (motor neuron disorders and polyneuropathy)

Table 9: Other medical conditions associated with muscle spasm.

1. Anemia
2. Raynaud phenomenon
3. Opioid withdrawal
4. Nonalcoholic liver cirrhosis
5. History of bariatric surgery

Prevalence of Muscle Spasm

The prevalence of muscle spasm in the adult healthy popula-

tion is 50-60% [37]. There are no differences between male or females except in pregnant women (usually in 2nd trimester, but also in 3rd trimester) [38,39], the incidence is about 30-50% [37,38]. The frequency of cramps increases with age [38]. There is a higher prevalence of muscle cramping in the elderly population and in endurance athletes [37,38,40]. In endurance athletes the incidence of muscle cramps appears to be associated with high intensity and prolonged duration [37,41]. About 40% of the participants of the studies on muscle cramps had cramp episodes more than three times per week, with an average duration of 9 minutes [37].

Patients with type II diabetes mellitus (DM) appear to have a higher age-adjusted prevalence of muscle spasm than individuals without DM II [42]. One epidemiological study showed that the age-adjusted prevalence of cramps was higher in patients with type II diabetes (65.2 vs. 45.5%; P = 0.009) but not type 1 diabetes (61.2 vs. 45.5%; P = 0.13) compared with healthy volunteers [42]. Patients with lower motor neuron disease, neuropathies and metabolic disorders increase the likelihood of muscle cramps [43]. Over 70% of patients with chronic liver disease report painful muscle cramps and a causal relationship (opposed to a simple association) has been described [43].

In the general population, NMC are present in 40 percent of individuals over age 50, increase in frequency with age and some report no sex preference [30,37], while others relate that woman are more likely to experience NMC than men [37]. NMC are associated with sleep disturbance and overall poor health [30].

Pathogenesis of Muscle Spasm

The origin of the mechanism of muscle spasm remains the subject of debate [36]. Described in the literature, muscle spasm or cramps are, however, believed to originate from spontaneous ectopic activity in the terminal motor axon (nerve terminals) [33,34]. leading to muscle pain caused by ischemia [35]. Muscle ischemia leads to a drop in pH and the release of pain-producing substances such as bradykinin, ATP and H+ leading to persistent, involuntary muscle contraction [35].

Electromyography during cramping event reveals variable high-frequency discharge of motor units at several sites, recruited either simultaneously or sequentially [33] with evidence that abnormal discharges come from both central and peripheral motor neurons [36]. According to Huang et al., evidence of peripheral origin includes variable EMG morphology of fasiculations, the fact that cramps can be induced by repetitive peripheral nerve stimulation and high-frequency discharge rates (: 150 Hz) [36].

Table 10: Clinical features of nocturnal leg cramps [1].

The following characteristics generally describe the clinical features of nocturnal leg cramps:

1. Symptoms of sudden muscle tightness are usually painful and most commonly occur in the calf, foot or thigh. Calf cramping may induce extreme plantar flexion of the foot and toes.
2. Duration of symptoms typically last from seconds to many minutes and are relieved by forceful stretching of the affected muscles. The average duration of nocturnal muscle cramps is nine minutes.
3. Timing of nocturnal muscle cramps typically occur while in bed; patients may be awake or asleep. Most individuals have these cramps only at night (73 percent) but can also occur during the day and night (20 percent of patients) and only during the daytime (7 percent).
4. Residual soreness may linger following the resolution of the acute cramp. Persistent soreness typically lasts for several hours. However, discomfort for up to 48 to 72 hours following resolution of the muscle cramp has been described. Nocturnal cramps affecting the thigh are more commonly associated with prolonged soreness than cramps affecting the calf and foot.
5. Frequency of nocturnal muscle cramps can occur three times a week in about 40 percent of individuals experiencing them, and 5-10 percent of individuals report nightly cramping.
6. Sleep disturbance is associated with nocturnal muscle cramps leading patients to complain of insomnia. Daytime fatigue is sometimes reported.
7. Seasonal variation is described in patients with nocturnal muscle cramps with higher prevalence in winter and summer. This variation is suggested by an analysis of the frequencies of new quinine prescriptions and internet searches related to leg cramps (both of which are doubled in winter compared to summer).

Relevant Studies

Choline, although essential in several metabolic pathways, is often overlooked as a macronutrient [44,52]. Choline regulates intracellular calcium, is a precursor of acetylcholine (the main neurotransmitter) and is involved in muscle contraction [52]. In addition, choline helps bind calcium-modulated proteins (e.g., calmodulin) to muscle receptors and helps to keep minerals like calcium bioavailable so the muscle can readily use it when it needs to contract [44,52]. A review of 28 relevant (unidentified) studies evaluated nutritional deficiencies and the functions of choline in regulating muscle contraction beyond its role as a precursor of acetylcholine (the main neurotransmitter) [44]. One study noted that supplementation of choline significantly reduced CPK (creatine phosphokinase) levels in a group of patients. CPK, a marker of muscle tissue damage, is often elevated in people who had a heart attack and in athletes (i.e., marathon runners) after particularly intense exercise. Based on the review, the authors recommended assessing choline levels in patients with skeletal muscle-related issues (e.g., muscle cramping in athletes or muscle soreness in others) and opined that evaluating choline status may be useful (to rule that out as a possible etiology of muscle spasm) [44].

Other available studies discuss effectiveness of nonpharmacologic treatments for muscle cramps. Overall, these reviews reveal insufficient data to support the effectiveness of nonpharmacologic treatments for muscle cramps. For example, although hydration for exercise-induced cramping is frequently recommended and employed by patients, there are no formal studies supporting its use [45,46]. Similarly, there is insufficient data that provide conclusions on the efficacy of calf stretching in reducing the frequency of muscle cramps [47,48].

One evidence-based study evaluating the efficacy of a particular treatment on muscle cramps as a primary or secondary outcome appraised 563 potential articles, with 24 meeting the inclusion criteria of prospective trials [51]. Class I studies showed the efficacy of quinine derivatives for treatment of muscle cramps although the benefit was reported as modest due to the quinine-related adverse effects from published prospective trials and case reports. Based on Class II studies, there

is some evidence that Naftidrofuyl (a vasodilator medication used outside the United States (U.S.) to treat peripheral and cerebral vascular disorders, vitamin B complex and diltiazem (a calcium channel blocker medication) may be effective in the treatment of muscle cramps [51]. Although magnesium supplements are widely used for prophylaxis and preventative treatment of nocturnal leg cramps, most Class II studies revealed that their use is probably not effective to treat muscle cramps [51]. In a Class I study in ALS, gabapentin (an anticonvulsant and nerve pain medication) was also deemed to be ineffective in the treatment of muscle cramps [51].

A randomized, double-blind, placebo controlled multicenter study tested the efficacy and safety of one type of magnesium preparation (magnesium oxide monohydrate – MOMH) for treating NLC [50]. This choice of magnesium supplement was selected due to its demonstrated increased cellular absorption rates in an ex-vivo setting [50]. 175 (81%) out of 216 initially screened subjects completed the study. At the conclusion of the study period, the number of NLC episodes had significantly decreased as compared to baseline in both groups ($p < 0.001$ for both) [50]. There was a significant between-group difference in the magnitude of reduction in NLC episodes ($p = 0.01$), indicating a higher decrease in the MOMH group as compared to the placebo group (- 3.4 vs - 2.6, respectively) [50]. In addition, MOMH treatment resulted in a greater reduction in NLC duration ($p < 0.007$) and greater improvement in sleep quality ($p < 0.001$) as compared to placebo [50]. The authors concluded that MOMH was safe, well-tolerated and appeared effective in the treatment of NLC [50].

History and Physical Examination

The role of history may provide important information about excluding alternate causes of muscle spasm symptoms. Patients should be asked specifically about symptoms consistent with restless leg syndrome (e.g., an urge to move the legs at night) or obstructive sleep apnea (OSA) (e.g., daytime somnolence, snoring) which may be associated with muscle cramps **(Table 11)**.

The role of the physical examination is to identify findings that may suggest an underlying cause or alternate diagnosis. Thus, in patients with muscle spasms or nocturnal muscle cramps, the Physical Examination (PE) of the muscles should be unrevealing [1]. Muscle cramps cannot be diagnosed based on PE alone. The lower extremities should be carefully inspected for abnormalities and looking for areas of tenderness, induration or other things that might indicate the presence of an alternate diagnosis.

A neurologic examination is recommended to assess motor strength and sensation looking for evidence of a neurologic disorder that might be associated with or mistaken for leg cramps. Identifying the presence of risk factors associated with nocturnal muscle cramps (e.g., pes planus, genu recurvatum and hypermobility) is reasonable to consider.

Table 11: Muscle cramping. Specific evaluation questions to ask:

1. Does patient have symptoms consistent with restless leg syndrome (RLS) (e.g., an urge to move the legs at night), obstructive sleep apnea (OSA) (e.g., daytime somnolence, snoring) which may be associated with muscle cramps?
2. Does the patient have any risk factors associated with nocturnal muscle cramps (e.g., pes planus, genu recurvatum, hypermobility) identifiable?
3. Does patient have underlying medical conditions? If so, what?
4. Does the patient take medications? If so, what medications does the patient take?
5. Does the patient have an exercise regimen? If so, what is it?

Laboratory Testing

Clinical suspicion of the underlying disease process should guide appropriate lab studies [28]. While not necessary to establish a diagnosis of muscle spasm or nocturnal muscle cramps, laboratory testing may be indicated for patients in whom the history and PE suggests an alternate diagnosis (e.g., iron deficiency in patients with suspected RLS or periodic limb movement disorder). Specific testing may also reveal an underlying cause of nocturnal muscle cramps in specific scenarios:

1. Hypokalemia (low potassium levels) in patients receiving diuretics
2. Electrolyte abnormalities in patients on dialysis
3. Hypomagnesemia (low magnesium levels) during pregnancy
4. Hypocalcemia (low calcium levels) with diffuse, recurrent or severe muscle cramping
5. Elevated thyroid-stimulating hormone (TSH) in patients with hypothyroidism

Diagnostic Imaging [54]

Imaging studies as appropriate in evaluation of muscle spasm assist to seek underlying causes of muscle injuries and bone disorders. For example, if clinically warranted, a plain radiograph of a lower extremity may demonstrate an abnormality in the bone such as fracture or dislocation as a potential cause of pain or spasm.

Magnetic Resonance Imaging (MRI) is the gold standard to detect muscle injuries due to its highly sensitive spatial and contrast resolution providing the capability to identify subtle injuries. MRI is used to evaluate muscles, ligaments and tendons with the precise ability to identify the location and extent of muscle strains. MRI can help to determine whether a strain is complete or partial thereby assisting with treatment decisions. MRI uses strong magnetic frequencies to create a detailed picture of the inside of the human body without the use of radiation.

Ultrasound (US) evaluation provides detailed images of muscle microanatomy. For example, it may be used to image the integrity muscles and soft tissue in the LE as a source of muscle spasm. It offers dynamic imaging (consolidation of digital imaging) although it is less sensitive than MRI to detect muscle edema and low-grade injuries.

Computed Tomography (CT) scanning is used to diagnose muscle and bone disorders and may be used if MRI is not available or recommended. CT scans uses x-ray beams that move in a circle around the body allowing the computer to interpret the data and display multiple views of the same structure on a computer monitor.

Management of Muscle Spasm

Management of acute muscle spasm can be achieved by; (1) slowly stretching and massaging the affected muscle (using

hands, a massage tool or a foam roller). (2) Application of heat with a warm towel, heating pad on low, warm shower or bath on the affected muscle may be helpful. Similarly, (3) application of cold (with cold gel pack, bag of frozen vegetables, bag of ice (wrapped in thin towel) on the affected muscle when it is slightly stretched may be helpful. (4) Prescription or over-the counter (OC) pain-relieving medications and muscle-relaxing medications may provide some relief of symptoms [1]. (5) Magnesium supplementation – MOMH.

While there are Class I studies showing the efficacy of quinine derivatives for treatment of muscle cramps, because of toxic effects from published reports and case studies, a Food and Drug Administration (FDA) advisory in 2006 warned against the off-label use of quinine sulfate and its derivatives in the treatment of muscle cramps [45].

Management of nocturnal muscle (leg) cramps and sleep related leg cramps, a common lower extremity condition, produces pain and can disrupt sleep involves; (1) prevention strategies, (2) medication therapy and (3) nonpharmacologic interventions such as the application of cold and warm compresses. Initial prevention strategies for prevention of recurrent attacks include daily stretching exercises. Trials of nonpharmacologic interventions can be added to daily stretching if desired.

Treatment of hypovolemia depends on the type of fluid loss a person sustains. If hypovolemia is believed to be the cause of muscle spasm, treatment of hypovolemia involves; (1) fluid replacement (For example, loss of fluid through vomiting, diarrhea or heavy sweating can lead to electrolyte imbalance causing muscle spasm due to hypovolemia). Mild cases can be treated by drinking liquids that contain sodium ("oral rehydration solutions"), sports drinks and broth in small amounts every 15 to 30 minutes [13,15]. (2) Correcting and maintaining sodium and water balance is achieved by eating when able to do so with choices that include lean meats, fruits, vegetables, whole grain breads and cereals [13]. (3) Severe cases of hypovolemia require hospital treatment with intravenous (IV) fluids to replenish the body's level of water [13,14] **(Table 12)**.

A nutritional and metabolic evaluation assessing for deficiencies is important to determine any imbalances that could be contributed to spasm and cramping. Examples of deficiencies may include choline, calcium, Vitamin D, potassium and sodium.

Table 12: Treatment of hypovolemia.

1. Drinking fluids that contain sodium, sports drinks and broths (in mild cases)
2. Eating lean meats, fluids, vegetables, whole grain breads, cereals (when able to do so)
3. Hospital treatment with intravenous ((V) fluids (in severe cases)
4. Dietary evaluation to assess for nutritional deficiencies

Discussion

Although there are many reasons individuals may experience muscle spasm, etiologies and mechanisms underlying symptoms of muscle spasm remain without a definitive cause. Underlying this rationale is evidence that risk factors and conditions tend to be anecdotal and possibly coincidental given a high prevalence of the symptoms, particularly in those with medical comorbidities. While muscle spasm may be related to or associated with underlying diseases, most symptoms are not caused by underlying medical conditions given the high prevalence of these symptoms in otherwise healthy adults. Examples of non-related disease causes usually include extreme fatigue from overexertion of a weakened muscle or repetitive activity, not using the muscle enough, or electrolyte imbalance (such as low magnesium or potassium levels). On the other hand, if a true muscle spasm is defined as the absence of a fluid and electrolyte imbalance, conditions related to hypovolemia and dehydration do not apply. Despite an association with an underlying mechanism or condition, symptoms of muscle spasm may appear similar in nature but are different depending on the involved muscle group or type of repetitive activity responsible for the attack. True muscle cramps are visible and palpable contractions in the muscle or part of a muscle, are acutely painful and have variable lengths of episodes. Some may last for only a few seconds to several minutes while others may present persistent tenderness and swelling for several days or longer following the initial episode of cramping.

Conclusion

Much of the symptom reporting on muscle spasm in the LE appears to be anecdotal and coincidental to an underlying cause. Similarly, much of what is recommended to treat and manage muscle spasm is based on insufficient data. Therefore, we are presented with the inability to reach evidence-based conclusions on efficacy of treatment. Although most symptoms of muscle spasm are without known cause, evaluation of potential or suspected causes may provide clues as to how to possibly prevent further attacks and manage acute episodes. Treatment may be based on symptomatic relief of acute symptoms with conservative measures. Prevention of acute muscle spasm events may provide the best option for remedies. For muscle cramps related to underlying medical conditions, controlling the disorder, if possible, is key to preventing the related symptoms. Acute management of spasm with associated comorbidities still involve gently stretching the muscle and using other conservative measures for comfort. In addition, a metabolic assessment may provide essential information on deficiencies that when corrected may help to contribute to a homeostatic balance within the body free from muscle spasm and cramps.

Conflicts of Interest: None
Funding: None

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