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EDITORIAL

- 2022** Editorial for the special issue of the Chinese Association for the Study of Pain
Peng BG, Liu YQ, Ma K

GUIDELINES

- 2027** Expert panel's guideline on cervicogenic headache: The Chinese Association for the Study of Pain recommendation
Xiao H, Peng BG, Ma K, Huang D, Liu XG, Lv Y, Liu Q, Lu LJ, Liu JF, Li YM, Song T, Tao W, Shen W, Yang XQ, Wang L, Zhang XM, Zhuang ZG, Liu H, Liu YQ

EXPERT CONSENSUS

- 2037** Expert consensus of Chinese Association for the Study of Pain on the application of ozone therapy in pain medicine
Zhuang ZG, Lu LJ, Peng BG, Ma K, Cai ZY, Fu ZJ, Liu GZ, Liu JF, Liu WT, Li XH, Song T, Wu DS, Yao J, Yao P, Yu JS, Liu YQ
- 2047** Chinese Association for the Study of Pain: Experts consensus on ultrasound-guided injections for the treatment of spinal pain in China (2020 edition)
Wang Y, Wang AZ, Wu BS, Zheng YJ, Zhao DQ, Liu H, Xu H, Fang HW, Zhang JY, Cheng ZX, Wang XR
- 2058** Chinese Association for the Study of Pain: Expert consensus on diagnosis and treatment for lumbar disc herniation
Cheng ZX, Zheng YJ, Feng ZY, Fang HW, Zhang JY, Wang XR
- 2068** Expert consensus of Chinese Association for the Study of Pain on the non-opioid analgesics for chronic musculoskeletal pain
Huang D, Liu YQ, Xia LJ, Liu XG, Ma K, Liu GZ, Xiao LZ, Song T, Yang XQ, Fu ZJ, Yan M
- 2077** Expert consensus on the diagnosis and treatment of myofascial pain syndrome
Cao QW, Peng BG, Wang L, Huang YQ, Jia DL, Jiang H, Lv Y, Liu XG, Liu RG, Li Y, Song T, Shen W, Yu LZ, Zheng YJ, Liu YQ, Huang D
- 2090** Chinese Association for the Study of Pain: Expert consensus on chronic postsurgical pain
Liu YM, Feng Y, Liu YQ, Lv Y, Xiong YC, Ma K, Zhang XW, Liu JF, Jin Y, Bao HG, Yan M, Song T, Liu Q
- 2100** Expert consensus of the Chinese Association for the Study of Pain on ion channel drugs for neuropathic pain
Xiao H, Ma K, Huang D, Liu XG, Liu TH, Liu Q, Liu GZ, Song T, Tao W, Wu DS, Wang YX, Yang XQ, Zhang XM, Liu H, Liu YQ
- 2110** Expert consensus of the Chinese Association for the Study of Pain on pain treatment with the transdermal patch
Ma K, Jiang W, Wang YX, Wang L, Lv Y, Liu JF, Liu RG, Liu H, Xiao LZ, Du DP, Lu LJ, Yang XQ, Xia LJ, Huang D, Fu ZJ, Peng BG, Liu YQ

- 2123** Expert consensus of Chinese Association for the Study of Pain on the radiofrequency therapy technology in the Department of Pain

Liu JF, Shen W, Huang D, Song T, Tao W, Liu Q, Huang YQ, Zhang XM, Xia LJ, Wu DS, Liu H, Chen FY, Liu TH, Peng BG, Liu YQ

MINIREVIEWS

- 2136** Contributions of aversive environmental stress to migraine chronification: Research update of migraine pathophysiology

Liu TH, Wang Z, Xie F, Liu YQ, Lin Q

- 2146** Cervical intervertebral disc degeneration and dizziness

Liu TH, Liu YQ, Peng BG

ORIGINAL ARTICLE

Observational Study

- 2153** Clinical efficacy of ultrasound-guided pulsed radiofrequency combined with ganglion impar block for treatment of perineal pain

Li SQ, Jiang L, Cui LG, Jia DL

ABOUT COVER

Editor-in-Chief of *World Journal of Clinical Cases*, Bao-Gan Peng, MD, PhD, is Professor and Director of the Department of Orthopedics at The Third Medical Center of PLA General Hospital. Professor Peng's research interest is spinal surgery. His career work has generated a multitude of new academic viewpoints and theories, and more than 200 academic papers, published both at home and abroad. In practice, he has systematically elucidated the pathogenesis of discogenic low back pain and established a new minimally invasive treatment method: The intradiscal methylene blue injection. He also revealed and characterized a new pathogenesis of Schmorl's nodes, which is a now a famous concept. Finally, he was the first to discover that ingrowth of Ruffini corpuscles into degenerative cervical disc is related to dizziness of cervical origin. (L-Editor: Filipodia)

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Expert consensus on the diagnosis and treatment of myofascial pain syndrome

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Abstract

Myofascial pain syndrome (MPS) is characterized by myofascial trigger points and fascial constrictions. At present, domestic and foreign scholars have not reached a consensus on the etiology and pathogenesis of MPS. Due to the lack of specific laboratory indicators and imaging evidence, there is no unified diagnostic criteria for MPS, making it easy to confuse with other diseases. The Chinese Association for the Study of Pain organized domestic experts to formulate this Chinese Pain Specialist Consensus on the diagnosis and treatment of MPS. This article reviews relevant domestic and foreign literature on the definition, epidemiology, pathogenesis, clinical manifestation, diagnostic criteria and treatments of MPS. The consensus is intended to normalize the diagnosis and treatment of MPS and be used by first-line doctors, including pain physicians to manage patients with MPS.

Key Words: Myofascial pain syndrome; Myofascial trigger points; Diagnosis; Treatment; Consensus; Pathogenesis

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Core Tip: Myofascial pain syndrome (MPS) refers to a type of chronic pain syndrome that recurs in muscles, fascia or related soft tissues and can be accompanied by obvious emotional disorders or dysfunctions. At present, domestic and foreign scholars have not reached a consensus on the etiology and pathogenesis of MPS. Due to the lack of specific laboratory indicators and imaging evidence, there is no unified diagnostic criteria for MPS, making it easy to confuse with other diseases. The consensus is intended to normalize the diagnosis and treatment of MPS and be used by first-line doctors to manage patients with MPS.

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INTRODUCTION

Myofascial pain syndrome (MPS) refers to a type of chronic pain syndrome that recurs in muscles, fascia or related soft tissues and can be accompanied by obvious emotional disorders or dysfunctions^[1]. MPS is characterized by myofascial trigger points (MTrPs) and fascial constrictions. The trigger points are sensitive to stimuli, causing localized pain and referred pain. MPS can occur alone or in combination with other diseases^[2]. The term "myofascial pain" was first proposed by an American scholar called Dr. Travell in 1952^[3]. After that, MPS, also called myofascitis, myofascial fibrositis, myositis, fibromyositis, muscle strain and myofascial syndrome, has attracted more and more attention from clinicians^[4]. At present, domestic and foreign scholars have not reached a consensus on the etiology and pathogenesis of MPS. Due to the lack of specific laboratory indicators and imaging evidence, there is no unified diagnostic

criteria for MPS, making it easy to confuse with other diseases^[5]. Therefore, the Chinese Association for the Study of Pain organized domestic experts to formulate this consensus in order to normalize the diagnosis and treatment of MPS.

ETIOLOGY

The etiology of MPS is not completely understood. Muscles and fascia suffering from aseptic inflammation may result in adhesion. It is currently hypothesized that the pain of MPS is due to the stimulation of sensory nerves by an algogenic substance in the inflammatory environment and the compression of inflammatory edema tissues. MPS generally occurs among those performing sustained low-level static exertions, such as office workers, musicians, dentists and other occupational groups^[6,7]. The residual tension produced by the persistent static force of long-term awkward working posture causes a blood circulation disorder of the skin. Accordingly, metabolites accumulate to stimulate the peripheral nerve endings, causing sensory nerve dysfunction including diffusion of referred pain, hyperalgesia and allodynia^[8-10]. At the same time, the sympathetic nervous system stimulation causes vasoconstriction of skin blood vessels and decreases the blood flow, forming a vicious cycle.

The causes of the development of MTrP can be divided into two categories: Predisposing factors and risk factors^[11]. Predisposing factors include: (1) Acute muscle injury or continual muscle stress; (2) Mental stress, overfatigue or insufficient sleep; and (3) Intense cooling of muscles. Risk factors include: (1) Hormonal changes and metabolic defects, such as hypothyroidism and menopause; (2) Nutrient deficiency: Vitamin B and iron deficiency; (3) Chronic infection; (4) Local chronic instability of biomechanics; and (5) Immune diseases. Traditional Chinese medicine believes that this disease is mostly caused by muscle strain, wind-cold dampness, obstruction of meridian and obstruction of Qi and blood.

EPIDEMIOLOGY

There are no accepted diagnostic criteria for MPS, resulting in a variable range of estimates from epidemiological studies. Most of the available data shows that MPS is usually related to musculoskeletal pain. MPS is a common disease that can be seen at any age, though mostly in elderly adults, athletes, hard physical laborers and sedentary workers. About 30.0% to 93.0% of patients with musculoskeletal pain suffer from MPS. About 46.1% of the patients reveal active MTrP in the physical examinations^[2,12]. Clinical studies have shown that at least 40.0% of skeletal muscle pain syndrome is mainly because of the activated trigger points in painful muscles^[13]. The predilection sites of MPS are the neck, shoulders and back. At present, the prevalence rate of chronic pain induced by trigger points is increasing annually. The patients suffering from MPS present as persistent pain, and the range of physical motion always decreases with the age increase.

PATHOGENESIS

The mechanisms underlying myofascial pain and formation of MTrPs are still unclear. Mense *et al*^[14] proposed that the MTrPs might be initiated by an abnormal increase of acetylcholine at the motor endplate, leading to a consistent muscle contraction, which may be enhanced in traumatic/microtraumatic conditions produced by a local acute or chronic overload. The consistent muscle contraction in turn increases local energy consumption and local ischemia. The changes may induce pain or pain hypersensitivity by enhancing the local release of nociceptive substances, including substance P, calcitonin gene-related peptide and proinflammatory cytokines^[15,16]. The substances can sometimes spread to adjacent spinal cord segments and cause referred pain characterized by MTrPs^[17]. The central pain sensitization can increase the excitability of neurons and the expansion of the neuronal receptive fields causing refractory referred pain^[18]. Alternatively, Stecco *et al*^[19] suggested that muscular fascia, a form of connective tissue, may undergo pathological change under overload and damage leading to the biomechanical change of muscles and eventually to the reduction of contraction force and flexibility of muscles^[20]. The inflammatory changes mentioned above may exacerbate the pathological change, leading to pain or

enhancing pain. The pathological change of muscular fascia may be related to the abnormal changes in myofibrils, fibroblasts and extracellular matrix^[21].

CLINICAL MANIFESTATIONS

MPS is often secondary to a variety of diseases or comorbidities. It is often unidentified and misdiagnosed, resulting in wrong treatment. Therefore, we should increase our understanding of the disease. Different parts of MPS have different clinical manifestations. The following are common characteristics^[22-26].

Symptoms

(1) Pain: It is characterized by regional pain, which is mostly acid distension pain, with a few associated with burning pain, jumping pain, numbness and sensory abnormality. It can manifest as persistent pain, and a few can be paroxysmal. Cold, fatigue and muscle overload can induce aggravating pain, which can be alleviated by mild activity and heat; (2) Stiffness and limited range of motion: It manifests as stiffness, weakness, decreased endurance of the affected muscles and loss of related muscle coordination. The test muscles contract randomly, and the patient suddenly stops pushing prematurely; (3) Dysautonomia: Corresponding segmental sweating, chilling, pallor, slight edema and vertical hair activity, *etc.*; (4) Proprioceptive disorder: Dizziness, tinnitus, imbalance feeling and weight perception disorder when lifting objects. It is common in head and neck MPS; (5) Depression: Long-term MPS leads to repeated visits for patients and suspected diseases, which may lead to depression. It is common in patients with mental stress. Conversely, depression can reduce the pain threshold and strengthen the pain, thereby forming a vicious cycle; and (6) Dyssomnia: Poor sleep quality is often caused by night pain and morning pain.

Signs

(1) Restricted movement: muscles with trigger points can be restricted from stretching due to pain during examination. No muscular atrophy; (2) Taut bands: Consisting of a group of tense muscle fibers, it is sensitive and persistently stiff at palpation. Taut band can be confirmed by palpation through pressing or pinching the muscles; (3) Painful nodules or ropes: Muscle spasm is a kind of involuntary muscle contraction. Unlike the muscle tension band that is limited to local muscle fibers, tenderness and hard texture spread to the entire muscle; (4) MTrP: It is a small and sensitive tenderness area that presents in the accessible taut bands and can cause pain in remote areas spontaneously during compression or acupuncture. Each trigger point has a specific area of referred pain; (5) Tenderness: Compression locally induces local pain rather than referred pain; and (6) Local twitch response: It is a temporary contraction of the muscle fibers on the taut bands associated with the MTrPs. When appropriate plucking palpation or acupuncture is given at the point of irritation, the muscle fibers of the trigger bands usually present a local twitch response.

Examination

Currently there are no routine laboratory and specific imaging studies to confirm MPS. The following examinations such as electromyography, infrared thermography and ultrasound elastography can assist the diagnosis.

DIAGNOSIS

With pathogenic factors or past suffering history

Clinical manifestations: (1) Symptom: Pain, stiffness and body movement limitation (the pain might be induced/enhanced or released by changing posture or body movement); with or without any other symptom(s); and (2) Sign: Restricted movement (might be induced/enhanced or released by changing posture or body movement), MTrPs and/or tenderness (or sore to touch). Accompanied with (or without) any other sign(s).

Pathological targets can be accurate through physical examination of body movement and/or biomechanical force evaluations.

Auxiliary examinations

(1) Imaging examinations (such as X ray, computed tomography, ultrasound imagination or magnetic resonance imaging) can help to recognize the musculature and myofascial locations, shapes, sizes, depths, elasticity, nodes and calcifications. Among them, more studies have been done on ultrasound imaging and magnetic resonance imaging; (2) Infrared thermal imaging helps with the evaluation of tissue blood flow, tissue metabolism and temperature changes; (3) Local myofascial elasticity can also be measured by means of some special tools; and (4) There is no accepted and definite laboratory basis that can be referred to.

For the diagnosis of MPS

The above 1 and 2 conditions must be compulsory^[22], while conditions 3 and 4 should be auxiliary.

DIFFERENTIAL DIAGNOSIS

MPS is easy to confuse with many diseases with similar clinical symptoms, and it should be distinguished from the following diseases.

Fibromyalgia

Fibromyalgia (FM) is a group of clinical syndromes characterized by general pain and obvious physical discomfort with unknown etiology, often accompanied by fatigue, sleep disorders, morning stiffness, depression, anxiety and other mental symptoms. In 2016, the American College of Radiology updated FM diagnostic standards^[27] that the diagnosis of fibromyalgia was independent of other diagnosis. The pain symptom between FM syndrome (FMS) and MPS is similar. The differences between them include the location of pain in MPS is relatively local, and there are obvious MTrPs in MPS, which are quite painful with referred pain on palpation. The differentiating features of MPS from FMS are listed in [Table 1](#).

Polymyalgia rheumatica

Polymyalgia rheumatica (PMR), a group of clinical syndromes, is characterized by symmetrical myalgia and stiffness in the neck, scapula and pelvis. The patients always show signs of mild tenderness. Most people who develop PMR are older than 50. The increase of erythrocyte sedimentation rate and C-reactive protein is one of the important diagnostic indexes of PMR in the acute phase^[28]. Patients with PMR usually respond well to low dose glucocorticoid treatment, which can be used as a diagnostic treatment.

Chronic fatigue syndrome

The diagnostic criteria for chronic fatigue syndrome (CFS) proposed by the Centers for Disease Control and Prevention in the United States include: (1) Main symptoms: An unexplained feeling of fatigue, which is severe enough to decrease a person's activity level by 50% or more; (2) Secondary symptoms: Low fever, pharyngeal pain, lymphadenopathy, myasthenia, myalgia, arthralgia, sleep disorders, neuropsychic symptoms and post exertional malaise lasting more than 24 h; and (3) Signs: Low fever, pharyngitis and palpable lymph nodes. CFS can be diagnosed by the main symptom, at least six of the secondary symptoms and two of the positive signs. The main symptom with at least eight of the secondary symptoms can also be the diagnostic criteria for CFS. At present, the diagnosis of CFS is based on the Centers for Disease Control and Prevention 1994 criteria^[29].

Polymyositis

Polymyositis (PM) is one of the idiopathic inflammatory myopathies. If patients are accompanied with skin lesions, then it can be called as dermatomyositis. The clinical symptoms manifest as symmetrical muscle weakness and pain, especially in the shoulder girdle, pelvic girdle and cervical muscles. Slow progressive atrophy can also be seen in the affected muscles. The diagnostic criteria proposed by the Chinese Medical Association Rheumatology Branch^[30] are as follows: (1) Symmetric proximal muscle weakness; (2) Elevation of serum levels of skeletal muscle enzymes; (3) Myopathic changes in electromyography; (4) Typical rash of dermatomyositis; and (5) Characteristic muscle biopsy abnormalities. A definite diagnosis of PM requires four criteria. Clinical diagnosis comprises three criteria, and possible diagnosis requires two

Table 1 Differentiating features of myofascial pain syndrome and fibromyalgia syndrome

Features	FMS	MPS
Female:Male	10:1	2:1
Pain range	Generalized	Relatively limited
Pain point distribution	Generalized	Relatively localized
Referred pain	No	Yes
Induration or stripe sensation	No	Yes
Injecting local anesthetics to MTrPs	No relief	Complete relief
Anatomical site of the MTrPs	Tendon attachment	Muscle belly
Myotonic rigidity	Generalized	Local
Fatigue	Yes	No
Sleep disorders	Yes	No
Prognosis	Difficult to cure	Good

FMS: Fibromyalgia syndrome; MPS: Myofascial pain syndrome; MTrPs: Myofascial trigger points.

criteria. PM mainly affects the proximal muscles. It can manifest as limb pain and weakness and trouble lifting the arms, which is similar to PMR. The difference is that perifascicular atrophy can be seen in PM. Moreover, PM always associates with high serum creatinine kinase levels and abnormal waveform in electromyography. Pathological examination of the muscle usually reveals perifascicular atrophy and lymphocyte infiltration in PM.

THERAPEUTIC PRINCIPLES AND METHODS

MPS is a relapsing disease. The foremost thing is that the etiological and inducing factors should be removed as much as possible, otherwise the curative effect may not be realized. Because there are many different treatment options available for MPS, treatment plans should meet the lesion site, course of disease and individual situation. Patients of short disease course and slight symptoms can select rehabilitation training and physical therapy. If a patient has a long course of disease, wide range of symptoms and unsatisfactory curative effects after accepting various therapeutic methods, then silver needle acupuncture therapy and percutaneous radiofrequency (RF) ablation accompanied with psychological therapy can be selected.

Physical rehabilitation therapy

The purpose of physical rehabilitation therapy for MPS is to restore the function of myofascial and to reduce the pain.

Extracorporeal shock wave therapy: Extracorporeal shock wave transmits the mechanical energy to the body through a certain medium and acts on the MTrPs and spasmodic muscle tissue without damaging the surrounding tissues. In the process of treatment, the trigger point of pain is located through the communication between physicians and patients, the so-called “biofeedback method”, so that the trigger-point of myofascial pain can be found. Combined with the divergent shock wave, it is used to relax the tense muscles, relieve the smooth muscles, locate and treat the superficial MTrPs and treat the large and/activated area of connective tissue. Focused shock wave is used to eliminate the lesion of tendon attachment point, decompose calcification deposition, locate the trigger-point and pain point, induce the “referred pain” and treat the trigger point in a superficial and deep way.

Hyperthermia, phototherapy and magnetic therapy: (1) Low frequency electrotherapy: Use pulse current with frequency less than 1000 Hz to treat; (2) Medium frequency electrotherapy: Use sinusoidal alternating current with frequency between 1000-100000 Hz to treat; (3) High frequency electrotherapy: The oscillatory current with frequency above 100 kHz and the electromagnetic field are used for treatment,

which has no exciting effect on nerve and muscle; (4) Phototherapy: Use all kinds of light radiation to treat; and (5) Magnetic therapy: It is a kind of physical therapy that uses the magnetic field on the human body to treat diseases with the effect of analgesia, detumescence and pain relief.

Manipulation, stretching and kinesiology tape: Manipulation and stretching refers to the method by which muscles are forced to move. The patient can complete the process in a relaxed state with no force and no muscle contraction. It can dilate vessels, accelerate lymph circulation and promote the absorption and excretion of inflammatory mediators to eliminate inflammation and edema of muscles. Kinesiology tape is an elastic ultrathin permeable tape with varying widths and elasticity. It can be cut into different shapes according to the needs and pasted on the muscles requiring treatment. It has the therapeutic effect of relieving spasms, relaxing muscles, improving incorrect movements, stabilizing joints, improving circulation, alleviating edema and relieving pain.

Drug therapy

In the current situation of limited etiology treatment, symptomatic treatment based on symptom relief is important to improve the quality of life of patients with MPS. We should prescribe oral medication at the lowest dose and the shortest course of treatment as possible, paying attention to factors including the patient's general condition, dosage, course of treatment and drug interaction in order to reduce drug-related adverse reactions and ensure the safety of drug use^[31].

Nonsteroidal anti-inflammatory drugs: Nonsteroidal anti-inflammatory drugs (NSAIDs) mainly have antipyretic, analgesic, anti-inflammatory and antirheumatic effects (such as ibuprofen injection, loxoprofen sodium cataplasms, *etc.*), which can effectively relieve pain. It is the most commonly used medicine to cure chronic pain diseases. Nonselective NSAIDs have strong anti-inflammatory and analgesic effects but also have obvious gastrointestinal side effects. The selective COX-2 inhibitors (such as celecoxib, etocoxib, *etc.*) can significantly reduce the occurrence of gastrointestinal adverse reactions. Factors that may increase the risk of NSAID related upper gastrointestinal adverse events (gastrointestinal ulcer, bleeding, perforation) old age, history of severe upper gastrointestinal ulcer or hemorrhagic disease, concurrent use of warfarin or other anticoagulants, use of oral corticosteroids or high dose NSAIDs, *etc.* Therefore, it is recommended to prescribe such drugs at the lowest effective dosage and shortest course of treatment as possible. It is forbidden for patients to take two NSAIDs at the same time^[32,33].

Anti-anxiety and depression drugs: In the treatment of chronic pain, 5-hydroxytryptamine and norepinephrine reuptake inhibitors (duloxetine, *etc.*) and tricyclic antidepressants (amitriptyline, *etc.*) are commonly used. Patients with chronic myofascial pain are commonly accompanied by anxiety and depression. Such drugs can relieve pain by alleviating the patients' psychological problems. The side effects of such drugs include dry mouth, constipation, blurred vision, *etc.*^[34]. It is generally recommended to start taking such drugs from a low dose and gradually increase to an effective dose.

Ion channel regulators: Sodium channel blockers (such as bulleyaconitine) and calcium channel blockers (such as gabapentin and pregabalin) are commonly used ion channel regulators and are used as the first-line drugs for neuropathic pain and for the treatment of MPS. The common side effects include drowsiness, dizziness and edema. Such drugs should be given at lower doses and increased slowly^[35].

Central muscle relaxant: Such drugs are mainly used to cure spasm or musculoskeletal related diseases by blocking the vicious cycle of skeletal muscle tension, *i.e.* hyperactivity of muscle tension, circulatory disorder, muscle pain and hyperactivity of muscle. Such drugs include tizanidine, chlorzoxazone, eperisone, baclofen, *etc.* It is recommended to treat patients with myofascial pain when NSAIDs are not effective alone or with muscle spasm^[36].

Opioids: Opioids including codeine, tramadol, morphine and oxycodone are mainly applicable for patients with moderate and severe pain on the condition that NSAIDs do not acquire efficacy. Such drugs are not used as the first-line drugs^[37].

Needle punching

Acupuncture and moxibustion: Acupuncture and moxibustion therapy are based on the theory of human meridians. The acupuncture needle is inserted into acupoints by twisting and lifting, and the moxibustion is another kind of therapy, which is burning the wormwood or moxibustion herbs to fumigate the acupoints on the body surface to stimulate specific parts of the human body. Acupuncture and moxibustion therapy have been widely accepted in the treatment of pain^[38]. In recent years, the research on acupuncture and moxibustion for MPS focuses on new therapies, new acupuncture instruments and multimode acupuncture. In addition, under the guidance of MTrP theory, dry needle therapy is gradually increasing in China^[39]. With respect to these methods, the total effective rate is good. The short-term effect of pain relief is satisfactory. However, the long-term cure rate remains uncertain^[40].

Silver needle puncture: The treatment of silver needle combined with heat conduction is an effective method for the treatment of intractable MPS. The diameter of soft silver needle body is 1.1 mm, and the tip is blunt, which increases the difficulty of scratching blood vessels and nerves making the treatment relatively safe. The operator inserts the silver needle into the tenderness point (area), then a small range of thrusting, lysis, separation and heat conduction are performed. The aseptic inflammation at the attachment of soft tissue was eliminated due to the deep heat effect in the myofascial membrane of the diseased tissue and periosteum. The silver needle acupuncture has been widely applied and popularized in the clinic for the high safety, simple operation, wide range of indication and excellent long-term effectiveness. The newly developed thin silver needle (0.6 mm in diameter) in the treatment of the small joints of the limbs and maxillofacial region gains some advantages, but the clinical report of long-term outcomes is lacking.

Acupotomy: Acupotomy is a blade shaped like a silver needle with a thick needle body and a needle tip of 0.8 cm wide, which can incise or peel off adhesion and small nodules of local soft tissues. For MPS, the mechanical stimulation and separation of acupotomy could enhance the activity of local tissues and accelerate the lymphatic circulation. The incision of scar tissue leads to the reduction of local pressure and pain. Because of its accessibility and convenience, it is widely used in China. However, the acupotomy should be utilized with caution or prohibited in some areas containing major nerves, vessels or organs due to the invisible operation with a sharp needle tip.

Internal heated needle: The internal heated needle, which is exerted by operators according to the theory of fasciology, is prodded into the fascia. Thereafter, it can produce accurate temperature from the tip of the needle to the treatment part of the needle body after it is connected to the temperature instrument. The internal heating could activate the body repair mechanism to achieve treatment effectiveness. Due to its short term application, there is no high-quality literature to support its definite long-term effect.

Injection techniques

Injection techniques are currently prescribed as one of the most comprehensive and important treatments in pain medicine. Injections, considered to function effectively for MPS, can be applied individually or combined with drugs and physical rehabilitation^[33].

The major complication of MPS injection is infection. Accidental puncture into a blood vessel or spinal canal can cause nerve injury to occur. A transient fever or pain can occur following this injection technique, and the patient should be warned of this possibility prior to the procedure. The process of injection should be entirely aseptic, and the vital signs of the patient should be monitored^[41].

Injection of local trigger points: Palpation with finger pressure prior to the procedure may find points inducing cord sensation and radiating pain. Injection would function better at the points where muscle twitching is induced during puncture^[42]. Then treating the scheduled area by means of typical MTrPs with careful palpation rather than on the basis of soft-tissue anatomy will result in a positive effect^[40].

In recent years, ultrasound-guided therapies for MTrPs have been widely used. Ultrasound guidance can improve the therapeutic success of injections in MPS-related cervical headache, shoulder pain, chest wall pain, back pain, *etc*^[43]. Ultrasound assists to identify deep MTrPs that cannot be observed by the naked eye. Observing local convulsive responses under the help of ultrasound supports positioning accuracy and improving efficiency^[44]. Puncture in this area with an in-plane or out-of-plane approach under ultrasound guidance to elicit a local convulsive response can locate

the trigger point to perform precise ultrasound-guided injection. Furthermore, injury to normal tissues can be avoided by the visibly real-time punctures, which eventually reduces incidents of complications^[45].

Neural blockade: Neural blockade is aimed at the myofascial areas of important nerve distribution. By inhibiting aseptic inflammation of peripheral nerves and separating and loosening local soft tissues, a therapeutic effect is produced. The procedure must be performed under ultrasound or X-ray guidance^[46].

Conventional medications: The medications for MPS injections include local anesthetic, corticosteroids and botulinum toxin^[47].

In combination with acupuncture and stretch therapy, a total of 0.1 mL to 0.5 mL of local anesthetic is drawn up as long as the puncture induces intolerable soreness or twitching in the patient. The stretch therapy should also be followed gradually and slowly as the puncture is completed. The most common dose of local anesthetics is 0.5% to 1% of lidocaine or 0.1% to 0.5% of ropivacaine. An additional small dose of corticosteroid may be needed in severe cases^[48].

The most common formulation of botulinum toxin applied for MPS is type A and B. Type A is conventionally prescribed, while type B is only prescribed for cases with type A failure^[49,50]. The suggested dose for a single trigger point or an individual “tight bandage” in muscles is 5 U, with a total dose of 15 U to 35 U in a 2-wk interval^[51]. The stretching exercise is also comprehensively required during injection therapies to consolidate the effects of the botulinum toxin with affected muscles.

Oxygen-ozone injection: Oxygen-ozone injection induces muscle twitching in the same way as stimulating MTrPs by a tiny needle producing a therapeutic effect similar to dry-needle treatment. Compared to corticosteroid injection, ozone can be metabolized and transformed into oxygen with the final absorption into the tissue, avoiding the side effect of local adhesion and the systematic response of a corticosteroid^[52]. The concentration of ozone injected should be no more than 30 µg/mL, with the dose of 1 mL to 5 mL for a single trigger point and a maximum of 30 mL at a time. Furthermore, the injection of ozone is recommended to be prescribed for one to three times in a week, with a course of treatment of 2 wk to 4 wk^[53].

RF treatment

RF technology has developed rapidly in recent years. It is one of the main treatment methods in pain medicine and an effective treatment method for MPS^[54]. The RF treatment for MPS can be divided into thermal coagulation RF and pulsed RF according to different RF energy output modes.

RF thermal coagulation treatment: RF thermal coagulation of myofascial pain is applied to the muscle fascia without important nerves around, such as the trapezius, supraspinatus, gastrocnemius, *etc.* The main targets of treatment are the MTrP and the fascia. The MTrP is determined physically upon palpitation. After that, the skin over the MTrP is marked and sterilized, a sterile surgical towel is placed, and a local anesthetic is administered with 0.5% lidocaine. Then, the RF cannula is inserted into the fascia under the guidance of ultrasound. The output temperature is set to be 75 °C and duration of 15-30 s. Thermal coagulation RF therapy can be performed at the same time for different MTrPs, while the same point can only be treated once a week.

Pulsed RF treatment: The energy output mode of pulsed RF is intermittent and of high intensity, which produces high voltage with low temperature. Therefore, it can avoid the damage of nerves around the needle tip. Pulsed RF of myofascial pain is applied to the muscle fascia with important nerves around, such as the scalenus, piriformis, gluteus medius, *etc.* During the procedure of local anesthesia, we should avoid injecting local anesthetics into the muscle layer near the treatment points. When the needle reaches the target fascia under the guidance of ultrasound, the parameters should be set to 42 °C for 120 s. Similarly, pulsed RF therapy can be performed at the same time for different points of myofascial.

The mechanism of RF therapy is to produce a therapeutic effect by damaging the abnormal peripheral nerve of local hyperplasia, separating and releasing the contracture of soft tissue and improving microcirculation^[55]. Several studies have shown that RF treatment of trapezius pain, psoas pain, heel pain and other MPS has a significant effect^[56-58]. The complications of RF treatment of MPS include the injury caused by puncture operation. Therefore, it is necessary to be familiar with the anatomical structure of the puncture site, pay attention to the direction and depth of puncture and carry out the procedure under the guidance of ultrasound or X-ray. In

addition, thermal coagulation RF may cause heat damage to local nerves, resulting in local skin numbness and other abnormal feelings. Therefore, before RF thermal coagulation, a stimulation test should be done to avoid damaging important nerves.

Psychotherapy and pain medicine health education

In chronic cases, patients are prone to anxiety, depression or somatization due to the recurrence of the disease and long-term torture of pain as well as economic, social and personal problems. For such patients, in addition to conventional treatment, health education and psychological treatment, such as the biofeedback, hypnotic analgesia and cognitive-behavioral therapy, should also be performed.

Existing studies and meta-analysis suggest that cognitive behavioral therapy can enhance the efficacy of MPS^[59,60]. Secondly, through exercise, stretching the muscles where the trigger points are located can help eliminate the trigger points and the pain they cause^[2,61]. Pain medicine education is conducive to the recovery of patients with MPS^[62].

CONCLUSION

Patients should be educated about the causes, treatment and prognosis of this type of pain. Patients should be encouraged to actively treat MPD, eliminate the fear of the disease, actively cooperate with medical care and eliminate the trigger points of pain through the above comprehensive treatment as soon as possible. In short, early treatment, good living habits and scientific and standardized exercise are the keys to early recovery of MPS.

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