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Frozen shoulder: Pathogenesis, Diagnosis and Treatment

Eman Mohmmad Rababah, M.Sc. [1], Hashem Abu Tariah, Ph.D. [2], Raed Halalsheha, Ph.D. [3], Mohamad Abo Kebar, B.Sc. [4].

1- Master Degree in Anatomy and Histology, Lecturer Hahemite University Faculty of Applied Heath Science, Department of Medical Laboratory Science Hashemite University Jordan (Corresponding author; E-mail: eaman@hu.edu.jo)

2- PhD in Occupational Therapy, Associated Professor, Faculty of Applied Heath Science, Department of Physical and Occupational Therapy the Hashemite University Jordan

3- PhD in Physiology, Assistant Professor, Faculty of Applied Heath Science, Department of Medical Laboratory Science Hashemite University Jordan

4- Lab Supervisor, Faculty of Applied Heath Science, Department of Physical and Occupational Therapy, Hashemite University Jordan

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Abstract

Frozen shoulder (FS) or adhesive capsulitis is a common disease which causes pain, difficulty and restriction in the movement of the shoulder joint due to unclear complex etiology. The everyday tasks such as bathing, dressing and driving become difficult. It affects both men and women especially in their 40s and 60s. The duration of the disease varies from one patient to another and it may last for up to three years. The symptoms of the disease vary from simple to sever and complex depending on the stage of the disease and the symptoms may vary from patient to patient. Currently, there is no consensus on what the best approach or guidelines can be as the best solution for FS. Our review will discuss the pathogenesis of the disease, early diagnosis, treatment methods and the rehabilitation of the patients during the period of the disease.

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Introduction

Frozen shoulder (FS) or adhesive capsulitis is a disease of unclear etiology which causes pain, difficulty and restriction in the movement of the shoulder (1). Patients with FS experience pain that is gradual and constant in the shoulder joint region which often increases during the night or cold weather (2). Interestingly, FS disappears over time and recovery can be obtained within one to three years (2).

FS is considered as one of the most common musculoskeletal diseases that is observed in the daily orthopedic practice (1,3) with an incidence rate of 2-5% in the general population (4). It occurs most commonly in middle age and elderly population (40s - 60s years old). It rarely affects the younger population (less than 40s) (5), and it is more common in women than men (5,6). The incidence rate increases in the diabetic population and reaches up to 20% (3). Furthermore, it has been found that patients with FS have a high risk to develop a prediabetic condition and present abnormal fasting sugar levels or glucose intolerance test (7).

The term FS was first used by Codman. In this disease, the main symptoms are pain near the insertion of deltoid and limitation in elevation and external rotation with a normal radiological appearance (5,8). In 1945, Naviesar used the term "adhesive capsulitis" instead of FS to define these symptoms (8). Currently adhesive capsulitis is used by several researchers and clinicians as well as by the American Academy of Orthopaedic Surgeons (AAOS)(9) in their definition of frozen shoulder.

Many arguments are put forward concerning the classification of FS, but it is generally ordered into two categories namely idiopathic (primary adhesive capsulitis) and acquired (secondary adhesive capsulitis), while the intrinsic type is not recognized (4). Zuckerman classified FS into primary and secondary and subdivided secondary FS into intrinsic, extrinsic, and systemic ones (10). The intrinsic group embraces the patients who have limitations in active and passive range of motions that occur in association with shoulder joint disorders (10,11). While the extrinsic group follows a distinguishable abnormality outside the shoulder such as trauma (2). The systemic group is related to the patients who have systemic disorders such as diabetes mellitus (10,11) and thyroid disorders (2).

Pathology

FS usually arises without an obvious preceding cause, or less commonly it can be associated with local or systemic disorders (1). FS often develops slowly following three different stages: the freezing, frozen, and thawing stages. Each stage can last for a number of months (12). The restriction in daily tasks and even simple movements such as, dressing, driving, normal sleeping, and bathing become impossible.

The first stage (freezing stage or painfull stage) is initiated by painful and contracture of the glenohumeral joint (5,13) as well as restriction in the range of active and passive movements of the shoulder joint (13,14). The range of motion (ROM) is mostly full with pain at the end of motion and the pain usually appears at night with sleep interruptions and it appears at rest especially when lying on the effected side. This stage may last between three to eight months (15). The second stage (adhesive stage, frozen or stiffness stage) may last four to six months. The pain in this stage starts to decrease and the progressive loss of glenohumeral motion occurs during this stage and pain is restricted to the end of stretching motion of the joint capsule (15). The third stage (recovery stage or thawing phase) lasts from one to three months and it is characterized by a decrease in pain and its gradual return and improvement of motion. The external rotation improves first followed by abduction and internal rotation (15).

Some studies suggested that the main cause of FS is the inflammatory contracture of the joint capsule which can be observed by using arthroscopy (1). Moreover, it was indicated that the increase in the amount of collagen fibers as a result of inflammatory reaction is the main cause for stiffness and fibrosis of the capsule leading to pain and restriction of the joint movement (13,16–18). Evidence shows that the activity of matrix metalloproteinases is one of the most acceptable molecular pathways which clarifys the frozen shoulder changes (19).

Some researchers consider a link between the changes in FS with the changes in Dupuytren's contracture even there is no evidence whether FS is a process similar to Dupuytren's contracture (1,5,17,20). New studies suggested that smoking

can be considered as one of the risk factors that will induce FS (21).

Histological findings in the Synovium

The inflammatory reactions in the frozen shoulder capsule can be recognized histologically (13). An immune-histochemical study reported the presence of collagen type III fibers in the anterosuperior capsule of FS patients as well as the increase in the transforming growth factor (TGF)-beta, platelet-derived growth factor (PDGF), and hepatocyte growth factor in FS patients when compared to those with nonspecific synovitis (22). Angiogenesis and neurogenesis were also found in the subsynovial layer (1,13,23). Also, the molecules related to mechanical stress appeared in the FS synovium (1,24). The fibrotic process can be confirmed by the presence of vimentine –positive cells in the joint capsule (13,25) at the same time using scanning acoustic microscopy specifying that the stiffness of FS capsule was greater than the stiffness of shoulder with rotator cuff tears (4).

Diagnosis

The early diagnosis is very important in treatment and helps to decrease the degree of stiffness and prevent long periods of pain. The diagnosis of FS depends on the history, signs and physical examination to the arm and shoulder. The stage and severity of the disease can be determined by following basic tests administered by a doctor as well as imaging investigations such as X-ray and MRI which play an important role in identifying structural problems. Blood tests, radiography and ultrasound are not the routine tests to diagnose FS and these investigations usually give normal results (26).

Examination

The examination and assessment of both passive and active shoulder movement for both upper limbs should be performed. Flexion, abduction, internal and external rotations are commonly examined (27). Most researchers suggest that about 50% decrease in the range of shoulder motion is a principle symptom for diagnosing FS (28).

Laboratory findings in frozen shoulder

There are certain hematological and immunological laboratory tests that are usually used to aid in diagnosing FS including complete blood cell count (CBC), erythrocyte sedimentation rate (ESR), C-reactive protein (29), thyroid-stimulating hormone (TSH) or Free thyroxine index (FTI) (30,31), human leucocyte antigen B27 (8) and serum blood sugar or glucose tolerance test (32). But, the history and physical examination are the basic routine methods for diagnosing FS (26). Some researchers reported the absence of autoantibodies in the serum of patients having the frozen shoulder. This supports the assumption that there is no autoimmune basis associated with this disorder (33). One of the most important laboratory findings is the significant increase in the lipids levels in the sera of FS patients (34).

Radiographic and imaging tools

A series of anteroposterior, lateral scapular and axillary view images are usually acquired to identify any changes in the anatomy of the shoulder joint or any abnormalities in the bone mineral density (BMD) as a result of limited shoulder movement or disuse. Generally, a plain radiograph would often show signs of decrease in the BMD at the head of the humerus after two months of the inception of FS symptoms (1).

Magnetic resonance imaging (MRI) has been used to detect an increase in the thickness of the capsule (35,36) as well as chronic synovitis, especially at the axillary region and coracohumeral ligament in the patients with frozen shoulder (8,37). Moreover, arthrography can be used for the assessment of FS (38), since it can detect the decrease in the joint volume which specifies the shortening in the capsule (1) with destruction of the axillary recess and subscapularis bursa (39). Some studies recognized that dynamic sonography can be considered as a consistent technique for diagnosing FS (40).

Treatment options for frozen shoulder

The main objectives of FS treatment are to alleviate the pain and preserve the mobility and flexibility of the shoulder since the severity of the disease continues for several years (2-3 years). Selecting the treatment approach is dependent upon the stage of the disease (8). Most researchers classify the treatment approaches into two categories: conservative and interventional therapy (26). The safest method of treatment is Motion Restoring Exercise, while the most risky treatment is surgery.

Conservative approaches

Painkillers

Non-steroidal anti-inflammatory drugs (NSAIDs) (i.e. Ibuprofen) and Acetaminophen (i.e. Paracetamol and Tylenol) are recommended for prolonged use to alleviate the pain. Nevertheless, the patient should follow the doctor recommendation since not all painkillers are suitable for every patient.

Exercise

It has been found that frequent and gentle exercises are better than intensive physiotherapy to prevent shoulder stiffness (8). Mild regular active exercises such as Codman's pendular exercises may help to decrease pain and conserve the tissues within and around the joint (41). Moreover, there was a significant improvement in 90% of patients with stage 2 adhesive capsulitis who performed twice a day four self-stretches (These stretches include passive flexion, horizontal adduction, internal rotation behind the back with the unaffected arm, and external rotation at 0° using a cane (42)).

Corticosteroid injections

The injection of steroids into the intra-articular glenohumeral joint reduces pain and swelling, and thus decreases the duration of the disease (43). Studies reported that intra-articular steroid injections could be more effective if they are used in the early stage of the disease (stage 1) (44–46). Some researchers advise against repeated corticosteroid injections as they may cause damage to the shoulder structures (47). Therefore, the duration of three to four weeks is recommended between each injection.

Superficial heat and cold

Superficial hot and cold packs are commonly used to promote repair and healing processes (41). Heat therapy using dry or moist packs is thought to reduce pain and stiffness of both joints and muscles. Placing cold packs after 10 minutes of heat therapy will reduce the inflammation and induce muscle relaxation, but studies recommend that cold packs should not be used more than 30 minutes as this will cause destruction to the skin or deeper tissues (41).

Physiotherapy

Several studies emphasize the importance and effectiveness of physical therapies in the treatment of FS (43). Moreover, physical therapy is a valuable tool in reducing inflammation and pain which allow re-establishing the normal shoulder movement (48). Physiotherapy depends on repetitive stretching exercises and improvement can be obtained in most cases (49). The studies recommended that using Transcutaneous Electrical Nerve Stimulation (TENS) along with physiotherapy, exercises and manual methods will improve the function and pain release of shoulder joint (50, 51).

Distension Arthrography (hydrodilatation)

A hydrostatic technique or Brisement method is based on injecting fluids such as saline or saline with steroids into the glenohumeral joint in order to stretch or break free the capsule (27). 30 ml of saline containing steroid will be injected into glenohumeral joint leading to the distention of the capsule, then the capsule will be ruptured as a result of high pressure (800 mmHg up to a maximum of 1500 mmHg) (28, 52) and the destruction usually occurs for either the biceps tendon sheath or the subcoracoid bursa (27). Many studies recommended that the distension arthrography is a reliable, safe and active tool for treating FS (52,53).

However, currently there are many unanswered questions concerning the mechanical aspects of this method. It is unclear whether capsule rupture must be achieved in order for the procedure to be successful or the dilatation is the key element of the treatment (52).

Interventional therapy

Manipulation under anaesthesia

Manipulation under anaesthesia is one of the most common techniques used to improve the range of motion in the FS within three months, particularly in patients who are unable to tolerate pain. Following this method, the shoulder joint is moved smoothly under general anesthesia (8).

Surgical release or Arthroscopic Release

Arthroscopic surgery is considered as a valuable tool in the treatment of FS (54). It is used to remove scar tissues or adhesion and any extra structures in the joint. This helps to speed up the recovery phase and release the stiffness. Arthroscopic surgery includes making two to three small incisions around the shoulder joint and then inserting an arthroscope through one of them in order to visualize the internal joint structure. This approach provides a very specific and selective capsular release (27).

Arthroscopic treatment is an effective therapy in the most resistant forms of FS. It was recommended that arthroscopic release can replace the manipulation under anesthesia (MUA) especially in diabetic patients because it decreases pain, reduces the recovery time and helps to return full range of movement without complications (8,55,56).

Open Release

The open release approach is often used to remove any adhesion in the capsule and it allows the removal of intra and extra- articular structures. It is the most invasive method and it is only considered when arthroscopic (57) or manipulation release have failed in treating patients with FS (58). The open release includes releasing the subacromial and subdeltoid bursal adhesions, the corocohumeral ligament and the rotator

interval utilizing a delto-pectoral method (57,59). This approach has been recommended in the past with rare cases as an effective treatment method in most resistant cases of frozen shoulder especially with post-operative cases (27).

Preventing frozen shoulder

Disuse is the main cause for FS. Activities and exercise maintain and increase the blood supply to the tendons and ligaments which is essential for the viability of these structures. Reducing the stress in the shoulder area and vitamin D as well as healthy diets also play a great role in decreasing the incidence of FS (60).

Rehabilitation

Many prospective and retrospective studies investigating the efficiency of rehabilitation after recovering from adhesive capsulitis indicated that higher extents of pain decrease scores and improvement in the ROM after different treatment methods (3). These studies indicated that administrating physical therapy in early stages may result in high improvement in the range of motion. However, the recovery of ROM and function was faster and better when physiotherapy was combined with intra-articular corticosteroid injection in comparison with injection therapy alone.

Role of Occupational therapy in frozen shoulder

Occupational therapists play a significant role in helping patients with frozen shoulder to return to their daily tasks and activities especially in severe cases (61,62). Occupational therapy usually depends on different types of interventions to evaluate and treat conditions of the shoulder complex associated with FS. These interventions vary from preliminary activities, such as modalities and ROM, to occupation-based interventions concentrating on client-centered roles and objectives. Interventions can be used in acute, subacute, chronic, and postoperative stages (62). A case report showed that using the occupation-based intervention in the early stages of diagnosis is very important in reducing pain and improving the range of motion (63).

Conclusion

Frozen shoulder is a common self-limiting condition in which the shoulder movement becomes restricted. The diagnosis of this condition is usually based on the physical examination and medical history of the patient. Treatment selection is dependent upon the FS stage and the complexity of the symptoms. Rehabilitation of the patients during the FS period is very crucial to alleviate the pain and symptoms and it may also be required after the completion of the treatment since patients do not regain the full range of shoulder motion in most cases.

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