The Egyptian Journal of Radiology and Nuclear Medicine (2016) 47, 929–936

Egyptian Society of Radiology and Nuclear Medicine

The Egyptian Journal of Radiology and Nuclear Medicine

www.elsevier.com/locate/ejrnm
www.sciencedirect.com

ORIGINAL ARTICLE

Reliable MRI and MRN signs of nerve and muscle injury following trauma to the shoulder with EMG and Clinical correlation

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Received 29 October 2015; accepted 27 March 2016
Available online 26 April 2016

KEYWORDS

MRN;
Nerve;
Muscle;
Shoulder

Abstract *Purpose:* To evaluate the role of MRN in diagnosis of suprascapular nerve injury and its relation with muscle injury after shoulder trauma in comparison with the EMG results. *Patient & method:* The study was carried on 30 patients following trauma to the shoulder, either direct trauma (80%) or indirect trauma in 20% presented clinically with shoulder pain and limited movements and referred for MRI examination. The MRI results were correlated with EMG results for all cases. *Results:* Those 30 cases were divided into 13 cases with acute onset, 10 cases with subacute onset and 7 cases with chronic onset. In acute injuries, 5 cases (5/30) showed combined nerve and muscle injuries, 4 cases (4/30) showed nerve injury only and 5 cases (5/30) showed muscle injury only. In subacute injuries 5 cases (5/30) showed combined muscle and nerve injuries and 5 cases (5/30) showed muscle injury only, in chronic 7 cases (7/30) showed combined nerve and muscle injuries, where EMG showed sharp waves only in 7 cases which are all chronic. *Conclusion:* MRN is the best modality in diagnosis of nerve injuries and associated muscle injuries in one sitting with no obvious difficulties in the examination. MRN associating with the routine MRI elevated the sensitivity of diagnosis.

1. Introduction

Nerve injuries of the shoulder are an unusual cause of shoulder pain and they result from a variety of causes including trauma (1). Traditionally, the diagnosis of muscle denervation was based on clinical findings, electromyography, and nerve conduction studies. However, electro-physiologic studies do not determine exactly the site of muscle denervation (2).

Abbreviations: MRN, Magnetic Resonance Neurography; EMG, electromyogram; BPI, Brief Pain Inventory; SSN, suprascapular nerve.

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Peer review under responsibility of The Egyptian Society of Radiology and Nuclear Medicine.

http://dx.doi.org/10.1016/j.ejrnm.2016.03.015

Magnetic resonance (MR) imaging has an important role in detection and characterization of pathologic conditions of skeletal muscles that cause changes in muscle signal intensity. There are many conditions that may affect muscle signal intensity, such as inflammation, traumatic and neurologic conditions (3).

Although the MR imaging findings of many conditions are similar, some distinct patterns of signal intensity abnormality may be recognized. The recognition of MR imaging patterns can allow one to narrow the differential diagnostic possibilities (4).

MRI has an important role because it can identify the exact site of injury depending on the muscle groups involved, provides information about the duration of denervation, and depicts the cause (2).

Additional clues to the diagnosis may also be present on the MR images and techniques thus allowing the differential diagnosis to be further narrowed. These clues may be appreciated in new imaging modality, Magnetic Resonance Neurography (MRN), which is an ever-advancing technology for multiplanar depiction of normal and abnormal peripheral nerves (5).

So, Magnetic resonance imaging (MRI), as non-invasive technique, provides valuable spatial information in making important diagnostic distinctions that cannot be readily accomplished by using other existing methods and allow direct anatomic visualization of a nerve, identification of the cause, and location of primary abnormalities while MRN, on other hand, has the ability to demonstrate intrinsic signal abnormalities within the nerve itself (6–8).

Here we are concerned about the suprascapular nerve injury and its effect upon the supraspinatus and infraspinatus muscles. The suprascapular nerve is a mixed motor and sensory peripheral nerve that arises from the upper trunk of the brachial plexus. It originates from the roots of C5 and C6 with variable contribution from C4, at the Erb's point. The nerve passes across the posterior triangle of the neck deep to trapezius muscle. It then runs along the superior border of the scapula to enter the supraspinous fossa inferior to the superior transverse scapular ligament. Finally the nerve curves around the lateral border of the spine of the scapula reach to the infraspinous fossa. It gives motor supply to both supra and infraspinatus muscles (9,10).

In this study we will highlight various pulse sequences for selective nerve visualization as well as their functional evaluation. We aimed at studying the different patterns of muscle denervation in addition to their relation to the shape and SI of the related nerves. Finally correlation between the signal changes in different types of nerve injuries and the findings of the nerve conduction study as well as the patient's clinical history will also be discussed.

2. Patient and methods

2.1. Patients

30 patients complaining of shoulder pain and 10 healthy volunteers as control group were enrolled in this study. Those patients were referred to Radio-diagnosis & Medical Imaging department from clinics of orthopedic and physical medicine departments for MRI evaluation and assessment. The study was performed at the period from September 2014 to September 2015. Approval of Research Ethics Committee (REC) of Tanta University and informed written consent were obtained from all participants in the study after full explanation of the benefits and risks of the procedure. Privacy and confidentiality of all patient data were guaranteed. All data provision was monitored and used for scientific purpose only.

The inclusion criteria included patients with shoulder trauma and sport injuries who developed shoulder pain, they are clinically fit to participate in the study and they have no contraindication to MRI. Exclusion criteria included Patients with congenital lesions, systemic disease as rheumatoid arthritis, history of previous steroid injection in the diseased shoulder, impingement syndrome or chronic inflammatory arthritis.

2.2. Methods

All patients of our study were subjected to the following:

I – Full history taking.
II – Clinical examination: Including general examination and local shoulder examination. The local shoulder examinations were done by single independent orthopedic surgeon and rheumatologist.
Shoulder pain was quantified with the Brief Pain Inventory – Questions 12 (BPI 12), which asks patients to rate their shoulder pain in the last 7-days on an 11-point numeric ration scale of 0–10, where "0" indicates "no pain" and "10" indicates "pain as worse as the patient can tolerate".

Patients were classified according to the orthopedic examination and time of injury into the following:

- *Acute injury (13 patients):* Localized swelling at the back of the shoulder mainly at the supraspinatus area, hematoma at the back at scapular region gravitating downward associated with subcutaneous hematoma. Tenderness at the back of scapula in both supra and infraspinatus areas. Limitation of the shoulder movement mainly in abduction in both active and passive movements.
- *Subacute injury (10 patients):* Minimal subcutaneous hematoma and tenderness, no swelling. Movement is painful at the last degree of abduction.
- *Chronic (7 patients):* No signs except for tenderness and positive tinel sign: percussion at the site of nerve causes paresthesia. Movements: active movement only is painful and limited with restricted abduction.

2.3. Time of examination following trauma

Acute injury: Examination within the first 1–2 weeks of injury.
Subacute injury: Within 3–4 weeks following trauma.
Chronic injury: More than 4 weeks following trauma.

MRI then was done followed by EMG study of the affected shoulder.