

Review

# The application of sonography in shoulder pain evaluation and injection treatment after stroke: a systematic review

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**Abstract.** [Purpose] This review article is designed to expose the application of sonography in shoulder pain after stroke. [Methods] A range of databases was searched to identify articles that address sonography examination, with or without ultrasound guided corticosteroid injection for hemiplegic shoulder pain (HSP). The electronic databases of PubMed, CENTRAL, CINAHL, Cochrane Library, Medline were searched. [Results] According to the articles identified in our databases research, sonographic technique has potential to provide objective measurements in patients with HSP. The main sonography finding of HSP included subacromial subdeltoid (SASD) bursal effusion, tendinosis of the supraspinatus and subscapularis tendon, long head of biceps tendon sheath effusion, and shoulder subluxation. Our analysis also revealed significantly decreased pain score (VAS) and increased passive external rotation degree in the steroid injection group than control group. [Conclusion] The sonography examination is useful for HSP assessment and ultrasound guided technique is recommended for HSP injection treatment.

**Key words:** Stroke, Shoulder pain, Ultrasound

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## INTRODUCTION

Hemiplegic shoulder pain (HSP) is one of the most common impairment after stroke<sup>1</sup>) with prevalence rates varying from 6.9% to 26% for point prevalence and up to 66.7% for lifetime prevalence in the general population<sup>2</sup>). The most painful and limited shoulder movement is usually lateral (external) rotation, followed by abduction<sup>3</sup>).

The associated factors of HSP include poor upper extremity function, shoulder motion limitation, shoulder subluxation, increased muscle tone on the shoulder, reflex sympathetic dystrophy, and rotator cuff injuries<sup>3-6</sup>). The standard imaging for assessing HSP are arthrography and shoulder magnetic resonance imaging<sup>7, 8</sup>), but these methods are time-consuming and expensive. Shoulder sonography is a convenient and inexpensive imaging tool for evaluating soft tissue injury among hemiplegic stroke patients<sup>9-11</sup>). Based on shoulder sonography, a high prevalence of periarticular soft-tissue injuries was reported in post stroke patients<sup>12, 13</sup>).

Corticosteroid injections are widely used for short-term pain relief for patients with shoulder pain<sup>14, 15</sup>). Ultrasound

(US)-guided injections are widely used because of the advances in image quality, decreased cost of use, portability and lack of radiation exposure<sup>16</sup>). Recently US-guided injections showed greater accuracy than landmark technology for all shoulder pain treatment, with the exception of the target space<sup>17-19</sup>).

Here, we will review the current use of ultrasound evaluation for HSP and compare the benefit of US-guided steroid injection to placebo for shoulder pain after stroke.

## METHODS

A range of databases was searched to identify articles that address sonography examination or ultrasound guided injection for hemiplegic shoulder pain (HSP). The search strategy involved entry of the word stroke with a combination of other words such as shoulder pain and (ultrasound or sonography or sonographic or injection). This is a narrative review and we choose the related high quality evidence based on our knowledge and experience. So, we were confident that we would be able to find the main answers to our question. The electronic databases of PubMed, CENTRAL, CINAHL, Cochrane Library, Medline were searched. This study also included randomized controlled trials (RCTs) comparing the clinical efficacy of steroid injection vs. placebo or other treatment options. Case series and case reports were excluded. Articles focusing on the comparison of therapeutic effect of intra-articular injection (IAI) vs. SSN were also excluded.

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**Table 1.** Main outcome compared steroid with placebo injection in HSP patients

Outcomes	Measure	ES	95% CI	I <sup>2</sup>
Decreased pain score (VAS) after injection	MD	0.73	0.15, 1.32 *	32%
Increased shoulder passive external rotation degree	MD	8.85	3.82, 13.87 *	0%

\*p &lt; 0.01

## RESULTS AND DISCUSSION

### *The sonography finding of HSP after stroke*

#### Subacromial subdeltoid (SASD) bursal effusion

Lee et al.<sup>20</sup> used ultrasound to evaluate adequately the rotator cuff, the long head of the biceps tendon and tendon sheath, rotator cuff interval, subacromial subdeltoid (SASD) bursa, acromioclavicular (AC) joint, and posterior glenohumeral joint in all study patients. They found if fluid accumulation was observed in the SASD bursa, with an increased thickness of > 2 mm and hyperaemia as observed by power Doppler imaging, bursitis was confirmed. In Falsetti's study the SASD bursal effusion rate was 26.6% in patients after brain injury<sup>21</sup>. In patients with increasing spasticity, high-grade sonographic findings, such as a rotator cuff tear or bursitis, were expected depicted on sonography<sup>20</sup>.

#### Tendinosis of the supraspinatus tendon

Supraspinatus tendon pathology was independent predictors of the development of HSP and was associated with HSP at the subacute and chronic stages during the first 6 months after stroke<sup>10</sup>. The sonographic signs of full-thickness cuff tear were described in detail by Ptaszniak et al<sup>22</sup>. The incidence of tendinosis of the supraspinatus tendon after stroke is 42.2% in Falsetti's study<sup>21</sup>. Patients are more prone to have morbid rotator cuff injuries with increasing age due to greater magnitudes of weaknesses caused by stroke<sup>23</sup>. Enhanced muscle tone in the upper extremities following stroke may have a protective role against injury of supraspinatus tendon<sup>23</sup>.

#### Long head of biceps tendon sheath effusion

Long head of biceps tendon sheath effusion after acute stroke was very common abnormality observed with US examination<sup>21</sup>. Bicipital tenosynovitis was confirmed when a thickened hypoechoic area, with increased power Doppler flow, was found around the biceps tendon. Ultrasonography is a potential method in the evaluation of these changes in hemiplegic shoulder<sup>24</sup>. An anechoic area (> 2 mm) around the long head of the biceps tendon in the transverse and longitudinal views was interpreted as effusion in the biceps tendon sheath<sup>25</sup>. Collinger et al. investigated ultrasound changes of biceps and supraspinatus tendon appearance after an intense wheelchair propulsion task. The subjects were more likely to have a darker, diffuse tendon appearance with a longer duration of wheelchair use or immediately after the propulsion task<sup>26</sup>.

#### Shoulder subluxation

Subluxation of the affected shoulder in post-stroke patients is associated with nerve disorders and muscle fatigue.

Kumar et al.<sup>9</sup> assessed the intra rater reliability of acromion-greater tuberosity (AGT) distance in different arm positions. They found that ultrasonographic measurements of AGT distance have shown to be reliable and valid in the assessment of glenohumeral subluxation (GHS) in patients with stroke. Pop T<sup>27</sup> also found that there was no subluxation of the shoulder on the healthy side, while on the paretic side, subluxation occurred in 25.3% of the patients. Shoulder subluxation in lateral distances is a predictor for supraspinatus tendonitis<sup>28</sup>. Ultrasonography is a quantitative method for evaluating the laxity and stiffness of the glenohumeral joint<sup>13</sup>.

#### Tendinosis of subscapularis tendon

The number of abnormal sonographic findings of the subscapularis tendon during the chronic stage was significantly higher than that during the acute stage<sup>28</sup>. The abnormal findings of subscapularis tendons for the shoulder sonographies were also found in Huang YC's<sup>29</sup> and Pong's<sup>30</sup> research. Repeated inappropriate stretching and passive range of motion (ROM) exercises often result in injury to these muscles. Shoulder stabilization exercise positively affects pain alleviation and functional recovery in shoulder pain patients<sup>31</sup>.

#### Other changes in sonography of HSP

Other changes in sonography of HSP include partial thickness tear of the rotator cuff, full thickness tear of the rotator cuff, and glenohumeral effusion<sup>10, 21, 24</sup>. Generic painful shoulder is another interesting phenomenon. In Falsetti's study some patients without subluxation or frozen shoulder, were classified as generic painful shoulder (even if there were no rotator cuff abnormalities). There are also no neurogenic heterotopic ossifications (NHO) could be observed in shoulders<sup>21</sup>.

### *The application of ultrasound-guided steroid injection treatment for HSP*

We identified 292 articles, of which 3 RCTs<sup>19, 32, 33</sup> conducted between 2000 and 2014 were eligible for this Meta analysis. All patients were randomized into one of the two technique groups: with or without ultrasound guided steroid injection group and placebo injection group. Pain score (VAS) of the patients who received steroid injection was significantly decreased than placebo group. The analysis also showed a significant increased passive external rotation degree in the steroid injection group than placebo group (Table 1). The risk of bias within the studies was medium due to bland of participants and personal bias and unknown quality.

Corticosteroid injections have been shown to be effective in the treatment of HSP in most studies<sup>19, 33</sup>. Recently, steroid injection for HSP through intra-articular, subacromial

(SA) and/or suprascapular nerve block (SSNB) has become popular, but the outcome is confused. Ingrid et al.<sup>32)</sup> found the triamcinolone injections decrease HSP and accelerate recovery, but this effect was not statistically significant. In their research, the injection was performed by experienced physicians via the posterior route by land mark. However, physicians using the blind injections can never be sure about the depth of the inserted needle. Also the accuracy rate of landmark guiding injections is poor especially in obese patients with no obvious landmark.

Shoulder girdle injections have traditionally been done 'blind' (anatomical landmark guided injections). The use of image guidance (fluoroscopy or ultrasonography) has been shown to improve the accuracy of injections for different anatomical locations of the shoulder girdle<sup>34)</sup>. US-guided injections have become more popular because of the recent advances in image quality, decreased cost of use, portability and lack of radiation exposure<sup>17)</sup>. Aly et al found that a significantly improved accuracy for US-guided injections into the biceps tendon sheath, glenohumeral joint and AC joint compared to landmark-guided injections<sup>17)</sup>.

Corticosteroid injection is frequently performed in patients with HSP; however, it is still controversial when it comes to its efficacy. Rah evaluated the effect of sub-acromial corticosteroid injection by ultrasound-guided on hemiplegic shoulder pain. The needle was advanced with real-time ultrasound equipment until the needle tip entered the bursa. Participants sat in an upright position and the arms were positioned behind their backs with internal rotation and hyperextension of the shoulder and with the elbow bent for longitudinal supraspinatus view<sup>19)</sup>. Lanzer also reported the improvements in the range of motion and pain of hemiplegic patients after intra-articular corticosteroid injection<sup>35)</sup>. Sub-acromial injection with corticosteroid is known to improve pain and function in non-stroke patients with rotator cuff disorder. Jeon et al.<sup>18)</sup> reported that US-guided suprascapular nerve block, intra-articular steroid injection, and a combination therapy on HSP significantly improved shoulder ROM and pain with time, but no statistically significant difference was found between them. Suprascapular nerve block is a safe and efficacious treatment of HSP<sup>36)</sup>. Without taking into guided injection technology and consideration various causes of the shoulder pain such as rotator cuff disorder, glenohumeral subluxation, adhesive capsulitis, complex regional pain syndrome, spasticity, and neuropathic pain, may have led to such negative results. If the trials include the patients with chronic symptoms, might have limited functional gain from a corticosteroid injection alone.

Sonography evaluation for soft-tissue injury with post-stroke hemiplegia is recommended. Ultrasonographic technique has potential to provide objective measurements in patients with HSP. US-guided corticosteroid injections also have gained widespread use, particularly in the hands of non-radiologists. The analysis in this study provides evidence that ultrasound-guided corticosteroid injections potentially offer a significantly greater clinical improvement over blind injections in adults with shoulder pain after stroke. Therefore, we believe that the US-guided shoulder injection technique can be a useful treatment that leads to improvements in stroke patients with shoulder pain. It is reasonable

to promote ultrasound technology in HSP assessment and ultrasound guided corticosteroid injection treatment.

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