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The Relationship of Painful Shoulder Development in Hemiplegia With Glenohumeral Subluxation and Functional State

Hemiplejide Ağrılı Omuz Gelişiminin Glenohumeral Subluksasyon ve Fonksiyonel Durum ile İlişkisi

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ÖZET

AMAÇ: Çalışmanın amacı hemiplejik omuz ağrısı (HOA) ve glenohumeral (GH) subluksasyon arasındaki ilişkinin belirlenmesi, HOA ve GH subluksasyon gelişimini etkileyebilecek faktörlerin değerlendirilmesi ve HOA'nın fonksiyonel bağımsızlık ve GYA üzerine etkilerini saptamaktır.

GEREÇ VE YÖNTEM: Çalışmaya inme polikliniğine başvuran 61 hemiplejik hasta dahil edildi. Hastalarda anamnez ve klinik muayene ile omuz ağrısı, subluksasyon sıklığı ve spastisite değerlendirildi. Üst ekstremite fonksiyonları Brunnstrom motor evrelemesi; Günlük yaşam aktiviteleri ve bağımsızlık, Fonksiyonel Bağımsızlık Ölçeği (FBÖ) ve Modifiye Barthel İndeksi (MBİ) ile değerlendirildi.

BULGULAR: HOA'nın, serebrovasküler olayın süresiyle, üst ekstremitenin Brunnstrom motor evresiyle, GH subluksasyon varlığıyla, spastisiteyle ilişkisi bulunamamıştır (p>0.05), ancak omuz abduksiyon ve fleksiyon hareketlerinde kısıtlılık ile omuzda ağrı gelişmesi arasında istatistiksel olarak anlamlı bir ilişki bulunmuştur (p<0.05). GH subluksasyonun spastisite varlığı ve derecesiyle ilişkisi bulunamamıştır (p>0.05), ancak üst ekstremitenin Brunnstrom motor evresiyle anlamlı derecede ilişkili olduğu bulunmuştur (p<0.01). Üst ekstremitenin Brunnstrom motor iyileşme evresi arttıkça subluksasyon görülme sıklığının azaldığı tespit edilmiştir. FBÖ, MBİ skorlarıyla ile omuz ağrısı ve GH subluksasyon arasında da anlamlı bir ilişki tespit edilememiştir (p>0.05).

SONUÇ: Bu çalışmada omuz ağrısının GH subluksasyon ile ilişkisi belirlenmemiş, ancak hareket kısıtlılığı ile HOA ilişkisi olası yumuşak doku lezyonlarını düşündürmekte, bu açıdan rehabilitasyon programları içinde omuz korunmasına yönelik eğitime önem verilmesi gerekmektedir. GH subluksasyon ile motor gelişim ilişkisi göz önüne alındığında rehabilitasyon programında omuz kaslarının erken dönemde aktivasyonunun sağlanması üzerinde önemle durulmalıdır.

Anahtar Kelimeler: hemipleji, omuz, ağrı, subluksasyon, glenohumeral, fonksiyon

ABSTRACT

OBJECTIVE: The aim of the study is to determine the relationship between hemiplegic shoulder pain (HSP) and glenohumeral (GH) subluxation, to evaluate the factors that may affect the development of HSP and GH subluxation, and to determine the effects of HSP on functional independence and activities of daily living (ADL).

MATERIALS AND METHODS: Sixty-one hemiplegic patients who admitted to the cerebrovascular accident clinic were included in the study. Shoulder pain, frequency of subluxation, and spasticity were evaluated with anamnesis and clinical examination. Upper limb functions Brunnstrom motor stage; Activities of daily living and independence were evaluated with Functional Independence Scale (FIM) and Modified Barthel Index (MBI).

RESULTS: The HSP was not associated with the duration of cerebrovascular accident, the Brunnstrom motor stage of the upper extremity, the presence of GH subluxation, or spasticity (p> 0.05), but a statistically significant relationship was found between the limitation of shoulder abduction and flexion movements and the development of pain in the shoulder (p <0.05). GH subluxation was not found to be associated with the presence and degree of spasticity (p> 0.05), but it was found to be significantly associated with the Brunnstrom motor stage of the upper extremity (p <0.01). It was found that as the Brunnstrom motor recovery stage of the upper extremity increased, the incidence of subluxation decreased. There was also no significant relationship between FIM, MBI scores and shoulder pain and GH subluxation (p> 0.05).

CONCLUSION: In this study, the relationship between shoulder pain and GH subluxation was not determined, but the relationship between limitation of motion and HSP suggests possible soft tissue lesions, and in this respect, education for shoulder protection should be given importance in rehabilitation programs. Considering the relationship between GH subluxation and motor development, early activation of shoulder muscles should be emphasized in the rehabilitation program.

Keywords: hemiplegia, shoulder, glenohumeral, subluxation, pain, function

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INTRODUCTION

Cerebrovascular accident is a common, global health problem that causes serious disability. It has been reported that weak hand-arm function continues in 30-66% of all affected individuals in the 6th month after cerebrovascular accident (1, 2). The nature of the lesion in the brain and added upper extremity complications are among the important reasons for this. Hemiplegic shoulder pain (HSP) is the most common upper extremity problem in cerebrovascular accident (3). HSP is characterized by localized tenderness in the biceps brachii and supraspinatus tendon and a shoulder pain that extends to the elbow and even the hand (4). The occurrence of pain can start from the first week and extend up to the 6th month. The frequency of shoulder pain in hemiplegic patients has been reported in a very wide range of 16-84% (5). Due to the large number of factors involved in the pathogenesis of HSP, a definite etiological reason cannot often be determined. GH joint subluxation, shoulder-hand syndrome, rotator cuff lesions, adhesive capsulitis, spasticity, brachial plexus injuries and central-thalamic pain are the most frequently accused causes (6).

GH subluxation may occur when the relationship between humerus and scapula is disrupted in different directions. However, inferior subluxation is the most common (7). In studies, its frequency has been found between 17-81% (8). Methodological differences and assessment methods are among the reasons for the wide range. GH subluxation begins to develop especially in the first 3 weeks when muscle tone is flaccid after cerebrovascular accident (9). There are conflicting results in the literature regarding the relation of GH subluxation with HSP. While some studies found a relationship between the two, there are also studies reporting that there is no relationship between them (10, 11, 12).

Understanding the relationship between HSP and GH subluxation, determining the clinical conditions that affect their development, and knowing their effects on ADL and functional independence will guide both the prevention of these complications and the treatments. For this reason, the purpose of our study is to determine the relationship between shoulder pain and GH subluxation in hemiplegia, to evaluate factors such as upper extremity function, spasticity, soft tissue lesions that may affect the development of HSP and GH subluxation, and to determine the effects of HSP on functional independence and ADL.

MATERIAL & METHODS

Sixty-one hemiplegic patients over 18 years of age, who were admitted to cerebrovascular accident outpatient clinic and diagnosed with cerebrovascular accident by clinical and imaging methods, were included in the study. Patients with communicative aphasia and loss of cognitive function, patients with known shoulder pain prior to cerebrovascular accident, patients who had major shoulder trauma or surgery were excluded from the study. Prior to the study, the approval of the clinical research ethics committee was obtained. Written informed consent forms were obtained from all patients included in the study. The demographic data of the patients included in the study, such as age, gender, education level and occupational status, and hemiplegic side, dominant hand use, time after cerebrovascular accident, additional diseases, cerebrovascular accident etiology (ischemic, hemorrhagic and other) were examined and recorded from the patient files. The presence of shoulder pain was determined by asking the patients and by physical examination, whether there was pain during palpation and passive movements. The presence of GH subluxation was evaluated by palpation of the distance between the acromion and the humeral head in the sitting position with the first finger. The presence of GH subluxation was considered when the space between the humeral head and the acromion on the clinically involved side was more evident on palpation than on the healthy side. Joint range of motion was evaluated by goniometric measurements.

Spasticity was evaluated using the Modified Ashworth Scale (MAS). In this scale, stage 0 indicates normal muscle tone, stage 4 indicates that the affected joint is rigid in flexion and extension (13). The motor function levels of the patients were evaluated by Brunnstrom stage of motor recovery scale. While stage 1 is characterized by flaccid muscle tone without active movement, in stage 6, spasticity disappeared and isolated muscle movements developed (14). The Functional Independence Scale (FIM) was used to evaluate the patients' functional independence. An increase in the score obtained in this scale indicates a higher level of independence (15). Independence in ADL was evaluated with the Modified Barthel Index (MBI). In this scale, 0 points indicate complete dependence and 100 points indicate complete independence (16).

Statistical Analysis

IBM SPSS Statics, Windows version 23.0 package program was used for statistical evaluation of the data (IBM Corporation, New York, US). Chi-square test was used to evaluate whether there was a correlation between variables and for descriptive statistics. Whether the variables fit the normal distribution was examined using the Shapiro-Wilk test, and non-parametric tests were preferred in cases where at least one group or variable was not suitable for normal distribution. In this case, comparison of independent groups was made using the Mann-Whitney U test.

RESULTS

The age range of the patients was 21-85 years, on average 59.9 years, 54.1% were female and 45.9% were male. The mean duration of illness of 61 patients after cerebrovascular accident was 15.5 (1-38) months, 52.5% of them were left hemiplegic and 47.5% were right hemiplegic. Clinical subluxation was found in 44.3% of the patients, and shoulder pain on the hemiplegic side in 49.2%. When the etiological factors were evaluated, 73.8% of the cases were due to ischemic, 18.0% hemorrhagic, and 8.2% other causes (Table 1).

Table 1. *Demographic and Clinical Data for the Patients*

Age (SD)	59.9 (15.1)
Gender n	
Female	33 (54.1%)
Male	28 (45.9)
Mean Disease Duration months (min-max)	15.5 (1-38)
Affected Side (n)	
Left	32 (52.5%)
Right	29 (47.5%)
Etiology (n)	
Ischemic	45 (73.8%)
Hemorrhagic	11 (18.0%)
Other	5 (8.2%)
HSP (n)	
present	30 (49.2%)
none	29 (47.5%)
Subluxation (n)	
present	27 (44.3%)
none	32 (52.5%)

SD: standard deviation, n: number HSP: hemiplegic shoulder pain

Shoulder pain was not associated with the duration of cerebrovascular accident, the Brunnstrom motor recovery stage of the upper extremity, the presence of clinical subluxation, the presence and degree of spasticity (p> 0.05), but a statistically significant relationship was found between the limitation of shoulder abduction and flexion movements and the development of pain in the shoulder (p < 0.05). Clinical subluxation was not associated with the presence and degree of spasticity (p> 0.05), but it was found to be significantly associated with the Brunnstrom motor recovery stage of the upper extremity (p <0.01). It was found that as the Brunnstrom motor recovery stage of the upper extremity increased, the incidence of subluxation decreased (Table 2). In the evaluation of ADL and functional independence; There was no significant difference between the FIM total, FIM motor and MBI results of the patients with and without HSP (p> 0.05) (Table 3).

Table 2. *Correlations of HSP and GH Subluxation with Clinical Findings*

		P value
HSP-GHS n=59	X^2: 2.924 (SD:1)	>0.05
HSP-Spasticity n=59	X^2: 1.37 (SD:1)	>0.05
HSP-Brunnstrom Upper extremity	X^2: 3.06 (SD:5)	>0.05
HSP-Flexion ROM	X^2: 20.58 (SD:11)	<0.05*
HSP-Abduction ROM	X^2: 20.52 (SD:11)	<0.05*
HSP-Dominant Extremity	X^2: 0.05 (SD:1)	>0.05
GHS-Brunnstrom Upper extremity	X^2: 13.08 (SD:5)	<0.01*
GHS-Spasticity	X^2: 2.57 (SD:1)	>0.05
GHS- Flexion ROM	X^2: 11.812 (SD:11)	>0.05
GHS-Abduction ROM	X^2: 10.309 (SD:11)	>0.05

GHS: Glenohumeral subluxation, SD: Standard Deviation, HSP: hemiplegic shoulder pain

Table 3. *Relationship of HSP with ADL and Functional Independence*

	HSP (+)	HSP (-)	p value
	med. (min-max)	med. (min-max)	
FIM Motor	56.5 (23-84)	64 (13-84)	0.926
FIM Total	90.5 (29-115)	95 (19-113)	0.773
MBI	67.5 (5-100)	80 (0-100)	0.537

FIM: Functional Independence Measure, MBI: Modified Barthel Index. Mann Whitney U test, HSP: hemiplegic shoulder pain

DISCUSSION

HSP is a common complication after cerebrovascular accident. Multifactorial etiopathogenesis makes its treatment difficult and at the same time affects the rehabilitation process negatively. Knowing the clinical factors affecting HSP, especially understanding the relationship with GH subluxation and determining the effects of HSP on ADL and functional independence will provide useful information in hemiplegia rehabilitation.

In our study, the frequency of HSP was 49.2% and the frequency of subluxation was 44.3%. Considering the previous studies on HSP in our country, Barlak et al. in their study with 187 patients, found the frequency of HSP to be 61% and the frequency of GH subluxation to be 57.7% (6). In the study conducted with the largest number (n: 1000) in this field in the literature, Demirci et al. found the frequency of HSP to be 54.8% (17). Although the findings of our study are similar to this aspect, the frequency of HSP is given in a wide range in the literature (16-84%) (5). There can be many different reasons for this. First of all, it is obvious that pain is a subjective complaint and it will be more difficult to express and evaluate pain, especially in individuals who have CVA, due to reasons such as aphasia, dysarthria and cognitive impairment. Pain definition is also used in different ways in studies. In some studies, only the presence of pain was questioned (18, 19), while in others it was also examined whether there was pain that occurs with passive movement (20). Again, studies on different patient groups are among the reasons for this difference. For example; While only rehabilitated patients were included in some studies, the frequency in patients with mild disability but not included in rehabilitation is often unknown (8).

In our study, HSP was not found to be associated with clinically detected GH subluxation. There are conflicting results on this subject in the literature. In some studies, a significant relationship was found between inferior subluxation and HSP (10, 21, 22). Among those with large patient groups, Demirci et al. and Suethanapornkul et al. found that the frequency of GH subluxation in hemiplegia patients with shoulder pain was statistically significantly higher in their studies (17). Still, in the study of Suethanapornkul et al., HSP did not develop in more than half of the patients with GH subluxation (3). On the other hand, there are studies arguing that there is no relationship between GH subluxation and HSP (11, 19). Barlak et al. could not find a correlation between GH subluxation and the presence and pain level of HSP (6). Although GH subluxation is a contributing factor to the development of shoulder pain, it is seen that GH can develop painlessly. GH subluxation can be seen from the first weeks of hemiplegia and can continue in both flaccid and spastic periods. During the flaccid period, the humeral head, which lacks proper support, turns inferiorly, and the joint capsule, surrounding soft tissue, muscles and nerves (brachial plexus) are exposed to tension. This process is not the same in all patients due to the individual differences of both motor recovery and factors such as positioning, support (shoulder strap) and rehabilitation. The fact that the pain is caused not only by passive stretching caused by subluxation, but also by soft tissue damage that develops due to the duration of the plegic arm deprived of support and repetitive tractions may be one of the reasons for the lack of a clear relationship between subluxation and shoulder pain (4, 12).

In our study, a correlation was found between HSP and the development of limitation of movement (flexion and abduction) in the shoulder joint. There are many studies in the literature that found a correlation between shoulder motion limitation and HSP (11, 19, 20). In their systematic review, Kalichman and Ratmansky collected the reasons for HSP under 3 main headings; soft tissue lesions, impaired motor control and tone changes, changes in central and peripheral nervous system activity. Accordingly, soft tissue lesions; rotator cuff lesions, adhesive capsulitis, bursitis (subacromial, subdeltoid), and myofascial pain (4). Restriction in passive movements in the shoulder joint in a hemiplegic patient may be primarily due to soft tissue lesions and spasticity. Barlak et al. found the impingement rate to be 61% and the rotator cuff tear rate to be 33% in patients with HSP. However, among the soft tissue lesions, they found a correlation only between adhesive capsulitis and HSP (6). Lee et al. in the study in which they evaluated patients with HSP by ultrasonography, found effusion in subacromial-subdeltoid bursa in 50.7% of 71 patients, supraspinatus tendon pathology in 21.2% and effusion in biceps tendon sheath in 50.9% (23). Hakuno et al. found 54.6% adhesive changes on the plegic side by arthrography in their study with 77 randomly selected hemiplegic patients (24). Rizk et al. in a study conducted with hemiplegic patients with pain and limited range of motion, they found adhesive capsules with a rate of 77% by arthrography (25). In these 2 studies, a significant correlation was found between HSP and adhesive capsule. In a recent study, Lee et al. evaluated clinical and MR arthrography images of 59 hemiplegia patients with GH subluxation. As a result; found a significant correlation between HSP and limitation of flexion and rotator cuff atrophy (26). As it is known, rotation movements of the scapula and humeral head are necessary for the GH joint to perform flexion and abduction movements without difficulty. Scapulo-humeral rhythm is disturbed by the loss of motor control and proper muscle tone in hemiplegia. External rotation of the humerus is prevented by the weakening of the external rotator muscles and the spasticity of the internal rotators. Again, the scapula cannot accompany the abduction of the humerus. As a result, the subacromial distance becomes narrower, especially in abduction, and the movement of the tuberculum majus under the acromion becomes difficult. As a result, tendonitis or tears occur in rotator cuff tendons, especially in supraspinatus. The compression of the tendons becomes more pronounced, especially when the shoulder is abducted more than 90 degrees. Considering that this patient population is generally old, degenerative changes and traction of the hemiplegic arm also contribute to the pre-cerebrovascular accident (4, 8, 9). The relationship between adhesive capsulitis and HSP can be two-way. While adhesive capsulitis can cause pain, shoulder pain can trigger atrophy, contracture and immobilization due to not using the adhesive capsulitis (27). Soft tissue pathologies that develop due to the aforementioned mechanisms and causes such as GH subluxation, arm traction, traumas may cause secondary pain by triggering peripheral neural HSP etiologies such as shoulder-hand syndrome and brachial plexus damage (4).

Another factor that can cause limitation of motion in the shoulder joint is spasticity. There are some studies in the literature that did not find a relationship between spasticity and HSP (6, 22). On the contrary, both Turner and Stokes and Bender and McKenna stated in their systematic review that spasticity is an important cause of HSP (8, 27). Spastic muscles can also be a source of pain. In many studies, it was reported that pain was reduced by phenol block applied to the subscapular nerve and botulinum toxin injection to the spastic muscles in the shoulder girdle (28-31). Braun et al. suggested that the spastic subscapularis muscle forces the shoulder into internal rotation, creating traction in the periosteum to which the muscles adhere, causing pain. They also found a reduction in pain with the surgical release of this muscle (32). In our study, no statistically significant correlation was found between HSP and spasticity. Nevertheless, the frequency of shoulder pain in patients without spasticity was 47%, while this rate was found to be 52% in patients with spasticity. The low number of patients may also be one of the factors that cause this.

In two different cohort studies, Lingren et al. and Suehanapornkul et al. found a negative correlation between upper extremity motor functions and GH subluxation (3, 21). Both Benlidayı et al. and Huang et al. separated the patients into two groups as those demonstrating poor (1-2-3) and good (4-5-6) motor functions according to Brunnstrom motor recovery stages in their studies. They found GH subluxation prevalence higher in patients demonstrating poor motor functions (33, 34). A relationship could not be detected among upper extremity motor function and HSP in our study. In fact, poor motor function is not a pain cause itself. On the other hand, while GH subluxation prevalence was the highest in Brunnstrom stage 3 in our study, it decreases as of stage 4. Muscle imbalance in shoulder girdle recovers with increasing muscle strength and normalizing tonus with motor recovery. Also, the GH joint can be better protected against trauma and gravity. A decrease in GH subluxation can also be expected as a result of this.

Suethanapornkul et al. although a significant difference was observed in the Barthel index scores in both groups between the beginning and end of rehabilitation between the patient groups with and without HSP in their study. They could not detect a significant difference between the two groups. (3). Gamble et al. similarly, could not detect a relationship between HSP and Barthel index scores (35). On the other hand, Demirci et al. and Roy et al. found Barthel Index scores of patients with HSP to be lower at discharge (17). Barlak et al. reported that while there was no significant difference between the FIM scores of patients with and without HSP at the time of their admission to rehabilitation, patients without HSP improved significantly more in FIM scores at discharge (6). In our study, no significant difference was found between patients with and without HSP in terms of MBI and FIM scores. Although there are evidences to support the negative effects of HSP on functional independence and ADL in the literature, it will be difficult to say that the mentioned correlations are only due to HSP. There are many components that can affect ADL and functional independence in cerebrovascular accident patients. Therefore, while separating patient groups according to the presence of HSP, it is very difficult to match them in terms of all other factors. We think that studies that have been planned in detail and include similar patient groups in terms of motor functions and complications other than HSP are needed.

The most important limitation of our study is the small sample size and inclusion of the patient group of a single clinic. Another limitation is that the development of GH subluxation and shoulder pain could not be evaluated during the treatment and follow-up processes due to the cross-sectional nature of the study.

CONCLUSION

In conclusion, we think that in the rehabilitation of the hemiplegic shoulder, importance should be given to the preservation of range of motion from the early period, to the education of patients and their relatives, to avoid traction, to use appropriate shoulder supports in order to prevent soft tissue damage. Again, considering the relationship between clinical subluxation and motor development, early activation of the shoulder muscles should be emphasized in the rehabilitation program. Finally, there are still unclear points in the etiopathogenesis of HSP. For this purpose, randomized controlled studies with large patient groups with long follow-up periods are needed.

Etik: Bu çalışmanın etik kurulu alınmıştır.

Ethics committee approval had been taken.

Yazar katkı durumu; konsepti; NŞ, AY, FNE, dizaynı; NŞ, AY, FNE, Literatür taraması; NŞ, ME, AY, FNE, verilerin toplanması ve işlenmesi; NŞ, AY, FNE, istatistik; NŞ, ME, AY, yazım aşaması; NŞ, ME, AY, FNE

Author contribution status; The concept of the study; NŞ, AY, FNE, design; NŞ, AY, FNE, literature review; NŞ, ME, AY, FNE, collecting and processing data; NŞ, AY, FNE, statistics; NŞ, ME, AY, writing phase; NŞ, ME, AY, FNE

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