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Intraarticular hydraulic distension with steroids in the management of hemiplegic shoulder

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Aim: The aim of this study is to compare intraarticular steroid administration and steroid administration with hydraulic distention of the glenohumeral joint in hemiplegic patients who had developed shoulder pain and limitation.

Materials and methods: The study consisted of 60 patients attending an inpatient rehabilitation program following a stroke. Each patient had shoulder pain and shoulder limitations . The patients were divided into 3 groups consisting of 20 patients each, according to their order of admission. Conventional physical treatment and rehabilitation (PTR) methods were applied to the patients in Group 1 (control group), conventional PTR and an intraarticular steroid were applied to Group 2, and conventional PTR, hydraulic distention, and the steroid were applied to Group 3. The patients were evaluated according to joint range of motion (ROM), pain (Visual Analogue Scale), and shoulder function before treatment, the first day of treatment, and 1 month after treatment began.

Results: ROM in all directions and function showed a statistically significant increase, along with a significant decrease in pain, 1 month after treatment in all groups. The improvement in the steroid + hydraulic distention group (Group 3) was statistically significantly better than in the steroid + PTR and control groups ($P < 0.001$).

Conclusion: We found a marked increase in the ROM in all directions, decreased pain, and better upper extremity function in hemiplegic patients with shoulder pain and ROM limitation 1 month after the steroid administration + hydraulic distention of the shoulder joint. This finding indicated that steroids together with hydraulic distention of the shoulder joint can be used as an inexpensive, easy, and effective method in hemiplegic patients with shoulder pain and ROM limitation.

Key words: Hemiplegia, shoulder pain, adhesive capsulitis, hydrodilatation

1. Introduction

Shoulder pain and shoulder dysfunctions are one of the main problems of hemiplegic patients. The incidence of shoulder pain in hemiplegic patients varies between 5% and 84%, and it is an important complication that affects daily activities (1). Shoulder pain is common and occurs within 6 months after stroke onset (2). Hemiplegia may lead to pain and limitation of shoulder function due to glenohumeral subluxation, adhesive capsulitis, complex regional pain syndrome, spasticity, and subluxation (3). Hemiplegic shoulder pain has been shown by clinical and arthrographic evaluation to be complicated. Adhesive capsulitis develops as a result of the chronic irritation, damage, inflammation, and subluxation in the joint capsule and leads to shoulder pain and limitation of motion with the addition of spasticity (4).

Shoulder pain and limitation have an unfavorable effect on rehabilitation results (1,3). The treatment of this complication is important in the prognosis of the disorder. Treatment methods include positioning, using a shoulder sling, joint range of motion (ROM) exercises, functional electrical stimulation, physical treatment and rehabilitation (PTR) procedures, local injections, manipulations, and surgery as necessary, though there is no consensus on the best treatment method at present (5,6). Corticosteroids are frequently used for the shoulder pain of hemiplegic patients in clinical practice (7–9). Hydraulic distention has been shown to be effective in adhesive capsulitis (10,11) but it has no application in the treatment of the hemiplegic shoulder in practice. Studies have shown that arthrographic saline hydraulic distention and steroid injection in adhesive capsulitis are effective on short-term pain, joint ROM, and function (12). We used these data when planning our study.

The aim of this study was to compare the effectiveness of conventional rehabilitation, intraarticular steroid administration, and steroid + hydraulic distention treatment on pain, joint ROM, and upper extremity

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function in hemiplegic patients who had developed shoulder pain and joint motion limitation.

2. Materials and methods

A total of 60 patients who had shoulder pain and shoulder limitation, chosen from patients who had been placed in our rehabilitation program as an in-patient following hemiplegia, were included in the study. Consent was obtained from the hospital ethics committee before starting the study. In-patients at our hospital between April 2008 and May 2009 who met the criteria were included in the study. Patients who were unconscious, had bilateral hemiplegia, or had experienced previous shoulder trauma or shoulder surgery were excluded. The age, sex, dominant hand, etiology, side affected, systemic diseases, and the duration of the problem were recorded. The patients were informed and written consent was obtained. The patients were examined and upper extremity motor level (Brunnstrom), spasticity (Ashworth Scale), joint ROM, and upper extremity function level were evaluated with the Functional Independence Measure (FIM) self-care section (13–15). The Van Langenberghe classification was used for grading shoulder subluxation (16). The pain level was measured with a visual analogue scale (VAS) both at rest and during activity. The patients were divided into 3 groups of 20 subjects each, depending on their order of admission. The ROM, activity, and at-rest VAS and FIM scores were evaluated on the first evaluation day (1 day after admission), the next day, and 1 month later. All evaluations were performed by the same physician. The physician did not know whether the patients had received an injection or not, making this a blind trial. Patient injections were performed by another physician. All 3 groups received PTR procedures (ROM exercises; active, assisted exercises; and neurophysiological therapy modality) from the physiotherapist while they were in-patients for 1 month.

Group 1's patients received only PTR administration (control group).

Group 2's patients received an intraarticular steroid and PTR administration.

Group 3's patients received hydraulic distention in addition to the steroid and PTR administration.

All injections were performed in a sterile manner using a posterolateral approach (17). The posterolateral aspect of the acromion was identified by palpation. The needle was angled approximately 30° anterior to the coronal plane and slightly superior to the transverse plane and then inserted just below the angle of the acromion to a depth of approximately 1.5 to 2 cm. The skin was prepped with a povidone–iodine solution and then 0.5 mL Jetokain® (2% lignocaine + 0.00125% epinephrine) was injected into the skin and the soft tissues overlying the joint capsule. This was followed by an intraarticular injection of 1.5 mL Jetokain + 1 mL Celestone Chronodose® (betamethasone disodium phosphate, 3.9 mg + betamethasone acetate, 3 mg). Group 3 underwent hydraulic distention with 20 mL of saline solution after 1 mL Celestone Chronodose + 1.5 mL Jetokain.

2.1. Statistical analysis

Data analysis was performed with SPSS for Windows, version 11.5. The Shapiro–Wilk test was used to determine whether the distribution of continuous variables was close to normal. Descriptive statistics were used to present continuous variables as mean ± standard deviation and median (minimum–maximum), while categorical changes were presented as number of cases and percentages.

The significance of the differences between the groups regarding the means was evaluated with one-way ANOVA, while the Kruskal–Wallis test was used for the median values. The post hoc Tukey test or nonparametric multivariate comparison was used to determine the responsible group(s) when one-way ANOVA or the Kruskal–Wallis test found statistical significance. Pearson's chi-square or Fisher's exact result chi-square test was used to evaluate categorical variables.

The Friedman test was used to determine whether the ROM and VAS levels within the groups showed a significant change over time. When a significant statistical result was found with the Friedman test, the Wilcoxon signed-rank test was used to evaluate the significance of the change in the self-care level before and after treatment to determine the responsible follow-up times. The independent t-test was used to determine whether there was a significant change in the FIM level after treatment compared to before treatment within groups.

$P < 0.05$ was considered statistically significant. The Bonferroni correction was used to control type I error in all possible multiple comparisons.

3. Results

There were 39 females (65%) and 21 males (35%) in the study, with a mean age of 63.3 years (±5.7). Hypertension was present in 86.6% of study patients, diabetes mellitus in 30%, heart disease in 25%, asthma in 5%, and hyperlipidemia in 18.3%. Additionally, hyperthyroidism, hypothyroidism, chronic obstructive pulmonary disease (COPD), anemia, depression, and dyspepsia were present at lower rates. The hemiplegia was on the right side in 32 patients (53.3%) and the left side in 28 (46.6%). The type of hemiplegia was thromboembolic in 43 patients (72%) and hemorrhagic in 17 (28%). There was no significant difference between the groups for age, sex, affected side, or etiology (Table 1).

Table 2 presents the distribution of the study patients by the degree of shoulder subluxation, ultrasonography

Table 1. Distribution of hemiplegic patients to the groups by demographic characteristics.

	Group 1		Group 2		Group 3		P
Age	65.2 ± 6.8		62.4 ± 8.2		62.4 ± 7.1		0.398
Sex	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	0.138
Female	13	(65)	16	(80)	10	(50)	
Male	7	(35)	4	(20)	10	(50)	
Etiology							0.210
Thromboembolic	17	(85)	12	(60)	14	(70)	
Hemorrhagic	3	(15)	8	(40)	6	(30)	
Side							0.648
Right	11	(55)	10	(50)	11	(55)	
Left	9	(45)	10	(50)	9	(45)	

Group 1 = control ; Group 2 = steroid; Group 3 = steroid + hydraulic distention.

Table 2. The shoulder subluxation degree, USG findings, and upper extremity tone of the study patients by group.

	Group 1		Group 2		Group 3		P
	(n = 20)	(%)	(n = 20)	(%)	(n = 20)	(%)	
Degree of Subluxation							0.747
Normal	1	(5)	2	(10)	2	(10)	
Grade I	8	(40)	7	(35)	6	(30)	
Grade II	9	(45)	11	(55)	9	(45)	
Grade III	2	(10)	0	(0)	2	(10)	
Grade IV	0	(0)	0	(0)	1	(5)	
USG							0.234
Normal	6	(30)	5	(25)	8	(40)	
Tendinitis / Bursitis	14	(70)	15	(75)	12	(60)	
Muscle Tone							0.037
Normal	8	(40)	2	(10)	2	(10)	0.028
Ash 1	6	(30)	12	(60)	5	(25)	0.048
Ash 2	5	(25)	4	(20)	12	(60)	0.015
Ash 3	0	(0)	1	(5)	1	(5)	0.437
Arm (Brunnstrom)							0.518

Group 1 = control; Group 2 = steroid; Group 3 = steroid + hydraulic distention.

(USG) findings, and upper extremity tone. We found a very high incidence of subluxation and tendinitis in our patients, with the 3 groups having tendinitis or bursitis at a rate of 77%. There was no difference between the groups for the degree of subluxation and shoulder ultrasound findings. The spasticity rate was 76%. The rates of spasticity were higher and similar to each other in the injection groups and lower in the control group. However, there was a statistically significant difference between the groups for upper extremity spasticity. There was no significant difference between the groups for the arm Brunnstrom staging of the patients.

Table 3 presents ROM measurements in all directions for the patients and their comparisons. There was no significant difference between the ROM measured in the 3 groups at first. Evaluation of the joint ROM for flexion and abduction before and 24 h after treatment showed no difference in the control group, while there was a statistically significant improvement in both the steroid and the steroid + hydraulic distention groups. Evaluation of joint ROM for internal and external rotation showed a statistically significant improvement only in the steroid + hydraulic distention group's patients after 24 h.

There was a statistically significant improvement in all groups regarding joint ROM in all directions 1 month after treatment when compared with pretreatment values (Table 3). The ROM measurements in all directions of the steroid + hydraulic distention group's patients showed a higher statistical significance level regarding the difference between pretreatment, 1 day posttreatment, and 30 days posttreatment measurements compared to the other groups ($P < 0.001$).

Comparison of the pretreatment, 1 day posttreatment, and 1 month posttreatment values for pain at rest and during activity in all 3 groups showed no change in the control group 1 day after treatment, while there was a statistically significant improvement in the steroid and steroid + hydraulic distention groups. Comparison of shoulder pain at rest and during activity between pretreatment and 1 month after treatment showed statistically significant differences in all groups. The decrease in the steroid + hydraulic distention group also

Table 3. Pretreatment and 1 day and 1 month posttreatment ROM measurements and comparisons.

	Pretreatment	24 h later	1 month later
Flexion			
Group 1	122.5 (100–145)[c]	124.5 (100–145)[b]	152.5 (121.2–170)
Group 2	110 (100–125)[a,c]	115 (105–130)[b]	142.5 (135–166.2)
Group 3	95 (85–110)[a,c]	102.5 (90–120)[b]	160 (150–170)
Abduction			
Group 1	107.5 (96.2–138.7)[c]	109 (96.2–138.7)[b]	130 (120–163.7)
Group 2	100 (86.2–128.7)[a,c]	105 (91.2–133.7)[b]	135 (126.2–155)
Group 3	87.5 (72.5–103.7)[a,c]	97.5(82.5–113.7)[b]	152.5 (140–173.7)
Internal Rotation			
Group 1	47.5 (40–55)[c]	48.5 (40–55)[b]	52.5 (45–60)
Group 2	40 (36.2–45)[c]	45 (40–50)[b]	52.5 (50–60)
Group 3	37.5 (35–40)[a,c]	45 (40–48.7)[b]	67.5 (61.2–70)
External Rotation			
Group 1	45 (45–50)[c]	47.5 (45–50)[b]	52.5 (50–55)
Group 2	50 (41.2–55)[c]	50 (45–58.7)[b]	60 (50–65)
Group 3	37.5 (30–45)[a,c]	45 (31.2–50)[b]	65 (60–68.7)

Group 1 = control; Group 2 = steroid; Group 3 = steroid + hydraulic distention.
[a] Statistically significant difference between pretreatment and 24 h posttreatment values ($P < 0.001$);
[b] statistically significant difference between 24 h and 1 month posttreatment values ($P < 0.001$);
[c] statistically significant difference between pretreatment and 1 month posttreatment values ($P < 0.001$).

had higher statistical significance than in the other groups ($P < 0.001$).

There was no difference in any group 1 day after treatment for self-care motor FIM evaluation, while a significant difference was present between the pretreatment and 1 month posttreatment values (Table 4). However, comparison of the degree of change showed a more statistically significant increase in self-care values in the steroid + hydraulic distention group than either the steroid + PTR or the control group ($P < 0.001$; Figure)

There was also an improvement in upper extremity functions in addition to ROM and pain in the evaluation 1 month after treatment in all groups. However, the improvements for all evaluations (pain, VAS, and FIM) were statistically larger in the steroid + hydraulic distention group.

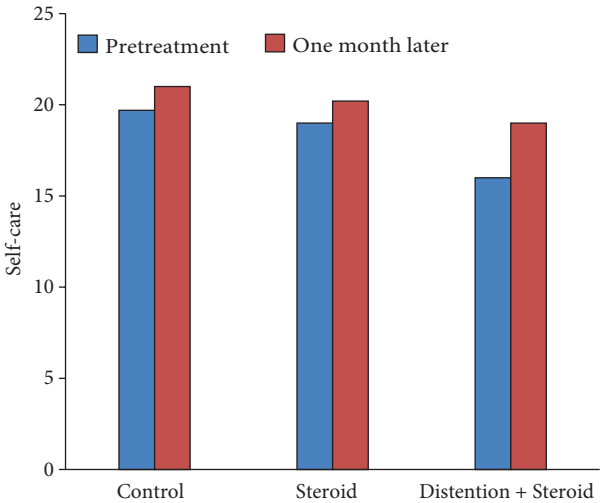

Figure. Changes between pretreatment and 1 month posttreatment values in the patients in the 3 groups for FIM self-care scores.

4. Discussion

Shoulder pain in hemiplegic patients can vary from mild to severe and causes a reduced quality of life (18). There are various opinions on the relation between shoulder pain and shoulder pathology. The general opinion is that subluxation is painless. However, the ischemia in periarticular structures and strain in the shoulder capsule due to the subluxation may cause shoulder pain (4) and the real problem is the limitation in shoulder joint ROM (especially passive external rotation) (19). Another pathology in stroke patients is adhesive capsulitis. Synovial capsule thickening, enhancement, and the rotator cuff interval enhancement were more frequent in hemiplegic shoulder pain group compared to contralateral asymptomatic shoulders (20). It is reported that spasticity of shoulder adductors, flexors, and internal rotators leads to shoulder pain and limitation of external rotation.

In light of the literature above, it seems that hemiplegic shoulder pain is complicated, with many factors acting simultaneously. However, there is no consensus on the best treatment method at present (5,6,21–23). We injected a steroid in one experimental group and used steroid + hydraulic distention in the other experimental group in this study, postulating that decreased joint fluid played a role in hemiplegic shoulder pain. We compared shoulder pain, ROM, and upper extremity functions between the group receiving conventional PTR only and those groups receiving injections. All our patients had shoulder pain, whether due to spasticity, shoulder joint inflammation, or subluxation. There are many systematic reviews and metaanalyses on the effectiveness of corticosteroid injections administered for nonhemiplegic shoulder pain (24,25). Corticosteroids are especially more effective than nonsteroidal medications for rotator cuff tendinitis for up to a 9-month period (24). Corticosteroids are frequently used for the shoulder pain of hemiplegic patients in clinical practice (7–9). Their effectiveness for pain, arm function, and daily living activities has been investigated. A recent retrospective case series reported that subacromial corticosteroid injection is associated with significantly reduced poststroke shoulder pain (7), but the evidence regarding adhesive capsulitis was inconclusive. Snels et al. administered intraarticular triamcinolone in their study and found no statistically significant difference despite

Table 4. The pretreatment and 1 month posttreatment self-care FIM levels of the patients in the 3 groups.

Self-care FIM	Pretreatment		1 month later		P
	mean	(min-max)			
Group 1	20.5	(16–29)	22	(17–30)	<0.001
Group 2	20	(17–29.5)	21	(19–30.7)	<0.001
Group 3	17	(14.2–21.5)	20	(18–23.7)	<0.001

Group 1 = control; Group 2 = steroid; Group 3 = steroid + hydraulic distention.

observing improvement in amount of pain and amount of function (8). In the current study, there was significant improvement in both pain (rest and activity VAS) and flexion–abduction in the corticosteroid and steroid + hydraulic distention groups at 1 day after treatment in our patients while the internal and external rotation difference was not marked. However, there was more improvement than in the control group in ROM measurements in all directions and all parameters (VAS and self-care and FIM values) at the 1-month evaluation.

We did not come across any study related to adhesive capsulitis treatment in hemiplegic patients in the literature. However, in nonhemiplegic patients, physical therapy, intraarticular corticosteroid injections, closed manipulation under anesthesia, arthroscopic capsular release, and open surgical release are carried out, but discussions on which of these options is the best one are in progress (26).

Some reports state a positive effect of hydraulic distention of the shoulder joint with high volumes of fluids on decreasing pain and increasing function (10–12). According to our systematic review, 5 studies that investigated the effect of arthroscopic distention in adhesive capsulitis are available. In these studies, it is reported that application of a steroid along with the saline distention is more effective on pain, function, and ROM than a placebo, and that distention combined with physical therapy has an influence only on function when compared with the physical therapy alone. Furthermore, the steroid combined with distention is more effective when compared with the steroid alone. On the other hand, the results of these studies may be questionable due to the high risk of bias. According to the authors, although they had a "sliver" level of evidence, the arthroscopic distention and application of a steroid have short-term effects on pain, function, and ROM with respect to alternative treatments (12). In another study in which an oral corticosteroid was compared with an intraarticular corticosteroid 3 times, it was stated that the intraarticular steroid was more effective in terms of pain, ROM, and patient satisfaction (27).

Hydraulic distention, with or without steroids, has been used for adhesive capsulitis only in nonhemiplegic patients in the literature. We did not come across any studies on hydraulic distention in the treatment of adhesive capsulitis in hemiplegic patients. A study using arthroscopy reported a positive correlation between joint ROM and decreased joint fluid in hemiplegic patients (4). We therefore felt that hydraulic distention could be effective in hemiplegic patients, even if the pathogenesis was different. The spasticity present in hemiplegic patients in comparison to nonhemiplegic patients is a confusing factor. One handicap of this study is the different spasticity levels between the groups (spasticity was more common in the injection groups). Steroid + hydraulic distention treatment was more effective in our hemiplegic patients, even though spasticity was present. The effect on ROM and the pain appeared quickly (1 day later) and still continued 1 month later. The effect on function also continued 1 month later. Steroids have no known effect on adhesive capsulitis and hydraulic distention has no known effect on inflammation. However, we saw that they were more effective when administered together. Steroid injection + hydraulic distention may have been effective on the pain and ROM both by suppressing the inflammation and increasing the joint volume, thereby decreasing the pressure on the supraspinatus and periarticular soft tissues. We cannot fully explain its effect on an extrinsic factor causing shoulder pain such as spasticity. We believe that the reason this was also effective in patients with spasticity may be because decreased pain from treatment interrupted the cycle of spasticity and pain. It may also be due to the minimal effect of spasticity on ROM limitation. These effects were limited in duration. Other handicaps of this study are that the patients were not followed for a long time and the long-term effect was not determined.

In conclusion, shoulder pain in hemiplegic patients is complicated and multifactorial. Although unable to explain it fully, we suggest that the use of a steroid + hydraulic distention is a valuable method in addition to conventional PTR applications for the shoulder pain of hemiplegic patients, as it is easy to use, inexpensive, and effective in a short time.

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