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Ultrasonographic Guided Intra Articular Steroid *versus* Hyaluronic Acid in Adhesive Capsulitis with and without Suprascapular Nerve Block: a Randomized Controlled Trial

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SUMMARY

Objective. To compare the effictiveness of intra articular injection (IAI) of steroid and HA with or without Suprascapular nerve block (SSNB) in the management of AC.

Patients and methods. Randomized controlled trial involved 80 patients (62 women and 18 men) clinically diagnosed as having adhesive capsulitis divided into 2 main groups: intra articular injection with SSNB (40 cases) and without SSNB (40 cases), each group divided into 2 subgroups. Twenty patients were treated with ultrasound guided intra articular injection of steroid (4 ml of 2% lidocaine and 2 ml of 40 mg/ml triamcinolone) and another twenty patients were treated with ultrasound guided intra articular injection of hyaluronic acid (4 ml of 2% lidocaine and 2 ml hyaluronic acid).

Results. Intra articular shoulder injection with SSNB has higher significant visual analogue scale (VAS) score at baseline and lower significant VAS score at 1st and 3rd week ($p < 0.001$). However, there was no significance between both groups regarding disability score at 3rd week ($p = 0.316$). In contrast, there was a high significance between them considering disability score at baseline, 1st, 6th week ($p < 0.001$ and 0.008, respectively).

Conclusions. In patients with adhesive capsulitis, both a combination an IAI alone or with SSNB dramatically improved pain and functional results. The use of an SSNB in conjunction with an IAI especially with steroid enhanced therapeutic effectiveness.

Study registration. Our study achieved retrospectively the pan African clinical trial registry acceptance No. PACTRA202111695655746.

KEY WORDS

Ultrasound; adhesive capsulitis; intra articular steroid injection; intraarticular hyaluronic acid injection; suprascapular nerve block.

INTRODUCTION

Primary adhesive capsulitis (AC) is a shoulder disorder characterised by a progressive and painful loss of both active and passive range-of-motion (ROM) in all planes of the glenohumeral joint, particularly external rotation, caused by progressive fibrosis and contracture of the glenohumeral joint capsule (1).

The American Academy of Orthopedic Surgeons has detailed how clinical manifestation such as history and clinical assessment are used to make a diagnosis.

The disorder affects around 2% to 5% of the overall population (2). AC treatment can be either surgical or non-operative, while the ideal approach is still debated (3).

Intra-articular steroid injections (IASIs) alone or with physiotherapy were previously reported effective treatment options that enhance rapid pain loss and early improvement in many soft tissue lesions and regional pain syndromes including AC (4, 5).

Suprascapular nerve block (SSNB) is another safe and acceptable therapeutic option for AC. It is beneficial in

lowering pain intensity and functional impairment, hence improving the quality of life of AC patients (6).

Hyaluronic acid (HA) is an ingredient of synovial fluid that is essential for joint lubrication and chondroprotection. Injecting HA into joints suppresses cytokine-induced reactions and reduces synovial inflammation, relieving pain and enhancing joint mobility (7). But the use of HA administration in the management of AC is not commonly accepted due to conflicting findings (8).

HA preparations has been proven to increase viability and regeneration and counteracted apoptosis in tendon derived cells (9).

Oliva *et al.* showed that anti-inflammator , wound healing, antiangiogenic, and immunosuppressive effects of HA have been reported *in vitro* and *in vivo* studies. These findings encourage the clinical application of HA in tendinopathies such as rotator cuff, epicondylitis, Achilles, and patellar tendinopathy (10).

In this study, we aimed to compare the effictiveness of intra articular injection (IAI) of steroid and HA with or without SSNB in the management of AC.

METHODS

This Randomized controlled trial involved 80 patients (62 women and 18 men), during the period from 10 December 2020 to 1 November 2021, with AC selected from outpatient clinic of Rheumatology and Rehabilitation Department, Al-azhar University Hospital, Assuit after acceptance of Ethical Committee (aa85\007\2022) and it conforms with the declaration of Helsinki for human experimentations (11).

We diagnosed AC by history of shoulder pain and limitation of passive and active ROM for at least three months. Secondary etiology of shoulder ache (*e.g.*, acute trauma, fractures, bony deformities, and glenohumeral joint disease) are contraindicated for block therapies (*e.g.*, bleeding disorder and infection) and chronic medical diseases were excluded from this study. All enrolled participants divided into 2 main groups: intra articular injection with SSNB (40 cases) and without SSNB (40 cases). Each group divided into 2 subgroups:

1) Twenty patients were treated with ultrasound guided intra articular injection of steroid (4ml of 2% lidocaine and 2 ml of 40 mg/ml triamcinolone).

2) Twenty patients were treated with ultrasound guided intra articular injection of hyaluronic acid (4 ml of 2% lidocaine and 2 ml hyaluronic acid).

All patients subjected to clinical assessment, imaging and routine laboratory investigations. Pre and post intervention assessment was done using both active and passive ranges, shoulder pain, disability index (SPADI) (12), visual analogue scale (VAS) (13), and range of movement (ROM) measurements by goniometer (14).

Technique of steroid and hyaluronic acid intra articular injection

The patient was seated, with the ipsilateral hand on the contralateral shoulder. The ultrasonic probe is positioned immediately caudal to the acromion, parallel to the scapular spine, above the infraspinatus tendon. The humeral head, labrum, infraspinatus tendon, and joint capsule are the most important features to recognize. The area was wrapped and aseptically prepped. The needle is inserted from lateral to medial via the infraspinatus muscle till the needle tip enters the junction of the humeral head cartilage and the lateral border of the posterior labrum. Following an aspiration to confirm that the needle was not inserted into an artery or vein, solution formed of 4 ml of 2% lidocaine mixed with 2 ml of triamcinolone (in steroid group) or 2 ml hyaluronic acid (in HA group) was injected, followed by manipulation of the shoulder joint (15) (**figure 1**).

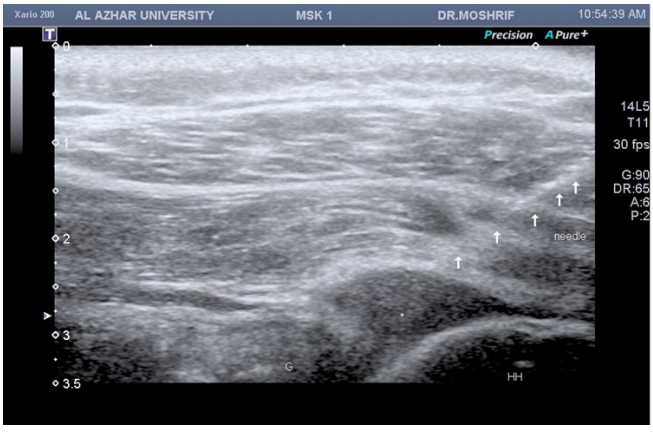

Figure 1. Ultrasound guided intra-articular injection of low molecular weight hyauronic acid for a 55 years old man with adhesive capceullitis.

HH: humeral head; G: glenoid.

Technique of suprascapular nerve block

The skin was disinfected with alcohol. The transducer (Toshiba Xario200 with a linear 10–12 MHz probe) is inserted along the scapular plane on the supraspinatus fossa. The transducer's midway is set to line with the lateral one-third of the scapular spine. The suprascapular nerve runs down the bottom of the supraspinatus fossa. The suprascapular artery can be seen as a pulsing dot next to the nerve, with positive Doppler signals. An in-plane method is used to insert the needle from medial to lateral until the needle tip pierces the deep fascia of the supraspinatus muscle or the transverse suprascapular ligament. Following an aspiration

to check that the needle was not in the suprascapular artery or vein, a solution of 10 ml of 0.5 percent bupivacaine for nerve block was injected, followed by shoulder joint movement (16).

Statistical analysis

Comparison between the study groups had been done using Kruskal wills test and F test. P-value less than 0.05 was considered significant. All statistical calculations were done using computer programs SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) version 15 for Microsoft Windows.

RESULTS

A total of 80 patients with AC enrolled in this study. Age of studied patients ranged from 42 to 64 years. There was no significance between groups regarding age, sex, BMI, disease duration and side of affection (**table I**).

Intra articular shoulder injection with SSNB has higher significant VAS score at baseline and lower significan VAS score at 1st and 3rd week ($p < 0.001$). However, there was no significance difference between groups regarding VAS at 6th week. There was significant difference between different period in all groups ($p < 0.001$) (**table II**).

There was no significance between groups considering disability score at 3rd week. In contrast, there was a high significance between them considering disability score at baseline, 1st, 6th week. There was significant difference between different period in all groups ($p < 0.001$) (**table III**).

There was no significance between groups considering active (abduction) at 6th week. In contrast, there was a highly statistically significant difference between them considering active (abduction) at baseline, 1st, 3rd week. Also, there was high significance between groups considering passive (abduction) at baseline, 1st, 3rd, 6th week. There was significance between different period in all groups in active and passive abduction ($p < 0.001$) (**table IV**).

There was high significance between groups considering active flexion and external rotation at baseline, 1st, 3rd, 6th week. Also, there was high significance between groups considering passive flexion and external rotation at baseline, 1st, 3rd, 6th week. There was significance between different period in all groups in active and passive flexion and external rotation **tables V, VI**).

Table I. Demographic and clinical data of studied groups.

Demographic data		Intraarticular shoulder injection Without (SSNB)				Intra articular shoulder injection With (SSNB)				Kruskal wills	P-value
		Steroid group (n = 20)		HA group (n = 20)		Steroid group (n = 20)		HA group (n = 20)			
Age (years) Median (IQR)		51.50 (42.0–60.0)		51.00 (46.0–55.0)		55.00 (50.0–64.0)		55.00 (50.0–59.0)		8.57	0.127 NS
BMI (kg/m²) Median (IQR)		27.00 (26.0–28.0)		26.90 (26.0–31.6)		27.30 (27.0–29.0)		25.30 (24.0–28.4)		7.69	0.174 NS
Disease duration (months) Median (IQR)		5.0 (3.0–7.0)		5.50 (5.0–8.0)		5.0 (3.0–6.0)		6.00 (4.0–7.0)		10.45	0.063 NS
		N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**Chi square**	**P-value**
Sex	Female	16	80 %	14	70 %	16	80 %	16	80 %	4.761	0.44 NS
	Male	4	20 %	6	30 %	4	20 %	4	20 %		
DM	No	8	40 %	10	50 %	6	30 %	8	40 %	2.175	0.744 NS
	Yes	12	60 %	10	50 %	14	70 %	12	60 %		
side of affection (ROM& Pain)	Right	10	50 %	14	70 %	14	70 %	8	40 %	7.67	0.175 NS
	Left	10	50 %	6	30 %	12	60 %	12	60 %		

Ns: no significant; S: significant; HS; highly significant; IQR: interquartile range; SSNB: suprascapular nerve block; HA: hyaluronic acid; N: number; BMI: body mass index; DM: diabetes mellitus; ROM: range of joint motion.

Table II. Distribution of VAS score among studied groups.

VAS	Intra articular shoulder injection Without (SSNB)		Intra articular shoulder injection with (SSNB)		Kruskal wills test	P-value
	Steroid group (n = 20)	HA group (n = 20)	Steroid group (n = 20)	HA group (n = 20)		
Baseline Median (IQR)	9.70 (9.50–9.80)	9.25 (9.0–9.6)	9.80 (9.7–9.90)	9.35 (9.0–9.70)	26.84	< 0.001 HS
1st week Median (IQR)	5.40 (5.0–6.15)	7.05 (5.07–8.22)	4.55 (4.0–5.00)	6.20 (5.25–8.07)	33.721	< 0.001 HS
3rd week Median (IQR)	4.10 (3.0–6.52)	5.15 (4.2–5.87)	3.50 (3.00–4.42)	4.05 (3.00–6.75)	24.12	< 0.001 HS
6th week Median (IQR)	1.05 (0.80 – 2.00)	2.50 (1.20 – 5.42)	1.00 (0.8 – 1.9)	1.60 (0.92– 5.62)	9.106	0.105 NS
Kruskal wills test	57.70	57.40	56.76	54.88		
P-value	< 0.001	< 0.001	< 0.001	< 0.001		

Ns: no significant; S: significant; HS; highly significant; IQR: interquartile range; VAS: visual analogue scale; HA: hyaluronic acid; N: number; SSNB: suprascapular nerve block.

Table III. Distribution of disability score among studied groups.

Disability score	Intra articular shoulder injection Without (SSNB)		Intra articular shoulder injection With (SSNB)		Kruskal wills	P-value
	Steroid group (n = 20)	HA group (n = 20)	Steroid group (n = 20)	HA group (n = 20)		
Baseline Median (IQR)	77.31 (76.3–80.3)	67.10 (64.5–70.5)	77.40 (67.5–78.4)	69.75 (65.4–71.3)	42.61	< 0.001 HS
1st weak Median (IQR)	45.75 (43.52–51.65)	52.58 (50.50–60.7)	40.60 (38.50–40.6)	43.00 (34.50–55)	38.49	< 0.001 HS
3rd weak Median (IQR)	31.00 (22–42.79)	33.30 (26.25–40.6)	28.50 (15.00–51.6)	30.50 (20.5–40.5)	5.903	0.316 NS
6th weak Median (IQR)	17.0 (14.25–29.7)	18.5 (14.25–23.3)	10.00 (5–19)	15.50 (10.5–19.7)	15.67	0.008 S
Kruskal wills	66.414	66.102	59.137	64.843		
P-value	< 0.001	<0.001	< 0.001	< 0.001		

Ns: no significant; S: significant; HS; highly significant; IQR: interquartile range; HA: hyaluronic acid; N: number; SSNB: suprascapular nerve blo

Table IV. Distribution of Active and passive (Abduction) by geniometer among studied groups.

	Intra articular shoulder injection Without (SSNB)		Intra articular shoulder injection With (SSNB)		Kruskal wills	P-value
	Steroid group (n = 20)	HA group (n = 20)	Steroid group (n = 20)	HA group (n = 20)		
Active Abduction						
Baseline Median (IQR)	112.0 (88.0–120)	98.00 (90.0–109.0)	132.0 (120.0–134)	104.5 (85.0–113)	30.72	< 0.001 HS
1st weak Median (IQR)	150.00 (125.0–169)	115.50 (99–120)	154.50 (150–168)	130.00 (117–157.5)	53.65	< 0.001 HS

	Intra articular shoulder injection Without (SSNB)		Intra articular shoulder injection With (SSNB)		Kruskal wills	P-value
	Steroid group (n = 20)	HA group (n = 20)	Steroid group (n = 20)	HA group (n = 20)		
3rd weak Median (IQR)	140.00 (112–180)	135.00 (105–162)	160.00 (122–182)	140.00 (106–179)	13.36	0.020 S
6th weak Median (IQR)	160.00 (140–179.7)	155.00 (131.5–170)	171.50 (156.2–170)	165.50 (139.7–170)	10.69	0.058 NS
P-value	< 0.001	< 0.001	0.005	< 0.001		
Passive Abduction						
Baseline Mean ± SD	110.6± 16.94	104.4 ± 17.86	131.6 ± 21.84	104.5 ± 9.02	13.54	< 0.001 HS
1st weak Mean ± SD	135.8 ± 16.5	130.6 ± 15.29	138.8 ± 17.76	135.7 ± 16.42	12.68	< 0.001 HS
3rd weak Mean ± SD	139 ± 15.44	137.4 ± 12.34	155.6 ± 13.4	142.3 ± 15.9	14.52	< 0.001 HS
6th weak Mean ± SD	150.1±11.39	148 ± 15.76	160.7 ± 11.15	155.9 ± 12.54	131.03	< 0.001 HS
P-value	< 0.001	< 0.001	< 0.001	< 0.001		

Ns: no significant; S: significant; HS; highly significant; IQR: interquartile range; HA: hyaluronic acid; N: number; SSNB: suprascapular nerve blo

Table V. Distribution of Active and passive (Flexion) by geniometer among studied groups.

	Intra articular shoulder injection Without (SSNB)		Intra articular shoulder injection With (SSNB)		F-test	P-value
	Steroid group (n = 20)	HA group (n = 20)	Steroid group (n = 20)	HA group (n = 20)		
Active Flexion						
Baseline Mean ± SD	137.9 ± 15.35	122.80 ± 14.6	146.2 ± 14.92	127.4 ± 24.57	8.241	< 0.001 HS
1st weak Mean ± SD	145.9 ± 16.07	128.0 ± 13.61	150.9 ± 14.00	132.4 ± 23.03	8.890	< 0.001 HS
3rd weak Mean ± SD	150.8 ± 16.56	134.1 ± 12.92	155.4 ± 13.91	137.7 ± 20.88	9.314	< 0.001 HS
6th weak Mean ± SD	159 ± 16.72	139.9 ± 11.88	168.8 ± 12.23	161.2 ± 20.02	11.25	< 0.001 HS
P value	< 0.001	0.005	0.180	0.010		
Passive Flexion						
Baseline Mean ± SD	139.8 ± 15.11	126.9 ± 14.76	148.2 ± 14.94	131.8 ± 24.33	7.316	< 0.001 HS
1st weak Mean ± SD	144.8 ± 15.87	131.8 ± 14.82	156 ± 12.93	136 ± 21.6	9.03	< 0.001 HS
3rd weak Mean ± SD	149.7 ± 15.16	138.8 ± 15.66	158.8 ± 11.67	142.5 ± 19.59	10.25	< 0.001 HS
6th weak Mean ± SD	154.2 ± 13.32	142.8 ± 13.49	161 ± 11.2	148.8 ± 14.44	13.03	< 0.001 HS
P-value	< 0.001	< 0.001	< 0.001	< 0.001		

Ns: no significant; S: significant; HS; highly significant; HA: hyaluronic acid; N: number; SSNB: suprascapular nerve blo

Table VI. Distribution of Active and passive (External rotation) among studied groups.

	Intra articular shoulder injection Without (SSNB)		Intra articular shoulder injection With (SSNB)		F-test	P-value
	Steroid group (n = 20)	HA group (n = 20)	Steroid group (n = 20)	HA group (n = 20)		
Active External rotation						
Baseline Mean ± SD	43.50 (30.0–48.0)	37.00 (28.0–39.0)	45.00 (43.0–50)	34.50 (34.0–44)	27.41	< 0.001 HS
1st weak Mean ± SD	45.50 (35–50)	41.50 (39–43)	50.00 (48–55)	45.00 (35–50)	36..657	< 0.001 HS
3rd weak Mean ± SD	55.00 (45–55)	50.00 (40–55)	60.00 (50–67)	55.00 (50–60)	45.98	< 0.001 HS
6th weak Mean ± SD	60.00 (60.0–67.0)	57.00 (50.0–67.0)	85.50 (70.0–95.0)	75.00 (67.0–83.0)	78.122	< 0.001 HS
P-value	< 0.001	0.005	0.180	0.010		
Passive External rotation						
Baseline Mean ± SD	43.5 ± 10.72	37.2 ± 8.06	45.9 ± 8.29	42.6 ± 8.82	8.47	< 0.001 HS
1st weak Mean ± SD	48.7 ± 10.28	41.9 ± 6.69	50.8 ± 7.77	47.3 ± 8.57	11.54	< 0.001 HS
3rd weak Mean ± SD	53.5 ± 6.68	50.6 ± 7.08	54.1 ± 9.83	52.1 ± 9.31	10.65	< 0.001 HS
6th weak Mean ± SD	58.3 ± 10.36	55 ± 6.32	79.05 ± 9.57	62.1 ± 6.56	14.25	< 0.001 HS
P-value	< 0.001	< 0.001	< 0.001	< 0.001		

Ns: no significant; S: significant; HS; highly significant; HA: hyaluronic acid; N: number; SSNB: suprascapular nerve blo

DISCUSSION

The current work aimed to compare the effectiveness of Ultrasonographic guided intra articular steroid versus hyaluronic acid injection in adhesive capsulitis with and without suprascapular nerve block in enhancing pain loss, improvement of function and disability. We found that there was no significant difference between groups as regards Age (years) and BMI (kg/m^2). In agreement with our results, Hsieh *et al.* (17) showed that there was no significance between groups as regards age, weight and height.

Our results showed that there was no significance between groups considering DM, side of affection, disease duration (years). In agreement with our results, Ranalletta *et al.* (6) reported that there was no significance between groups considering duration of symptoms, diabetes and shoulder dominance.

As regards DM our study included 60% diabetic patients. This high incidence of adhesive capsuilitis of shoulder in diabetis mellitus was coincide with (Zreik *et al.* (3)).

Our results considering VAS revealed that There was no significance between groups considering VAS at 6th week. In contrast, there was a high significance between them considering VAS at baseline, 1st, 3rd week. D'Orsi *et al.* (1) demonstrated that intra articular intra-articular steroid injections provide better results than oral steroid treatment with lower risk of side effects. Intra-articular injections may be more efficacious in the early stages of disease when the inflamm - tory processes are predominant and there is not a significant capsular contracture.

Our results considering VAS revealed that There was no significance between groups considering VAS at 6th week. In contrast, there was a high significance between them considering VAS at baseline, 1st, 3rd week. Dogru *et al.* (18) demonstrated that VAS score was measured prior to therapy, after the tenth session, and three months afterwards. During repeated pain assessments, significant improvements were seen in both groups ($p < 0.001$). However, there was no significance between groups

Ranalletta *et al.* (6) showed that mean baseline VAS score in the two groups was comparable (intervention/control: 7.5/7.6; $p = 0.783$). At all time periods, independent of treatment group, there was a significant improvement in

pain. The average VAS score in both groups had fallen by around 6.5 points at the conclusion of the follow-up period as compared to the baseline value. Pain alleviation, on the other hand, was substantially faster following a corticosteroid injection than after oral NSAIDs. This difference was most noticeable at the start of the research and continued for up to 8 weeks ($p = 0.001$). Pain improved dramatically in the control group between follow-up weeks 8 and 12, resulting in a nonsignificant intergroup difference at 12 weeks.

In our study we found that that there was no significance between groups considering active abduction at 6th week. In contrast, there was a highly statistically significant difference between them considering active abduction at baseline, 1st, 3rd week. We also found that there was high significance between groups considering passive abduction at baseline, 1st, 3rd, 6th week.

The study of Dogru *et al.* (18) stated that shoulder ROM was measured before therapy, after the tenth session after treatment, and at the three-month in controls. There was a significance among groups considering pretreatment values of passive abduction ($p = 0.03$). After assessing the repeated abduction measures, significant enhancements were seen in both groups ($p = 0.0001$).

The study of D'Orsi *et al.* (1) demonstrated that the use of corticosteroids in the treatment of AC led to fast pain relief and improved ROM. Three high quality RCT compared steroid injections with placebo, supervised physiotherapy and intra-articular sodium hyaluronate injection. All trials showed significant benefit of intra-articular injections on pain and shoulder disability at short term follow-up. No differences were found beyond 3 months between treatments.

Our findings considering active flexion revealed that there was high significance between groups as regards active fle - ion at Baseline, 1st week, 3rd week, 6th week. Also, considering passive flexion, there was high significance between groups at baseline, 1st, 3rd, 6th week. Considering active external rotation revealed that there was high significance between groups considering active external rotation at Baseline, 1st week, 3rd week, 6th week. Also, there was high significance between groups considering passive external rotation at baseline, 1st, 3rd, 6th week.

Hsieh *et al.* (17) illustrated that active and passive ROM enhanced with prolongation of treatment period considering flexion, external rotation, and internal rotation with no significance between groups

Treatment of adhesive capsulitis includes also physiotherapy programs especially end-range mobilization techniques and therapeutic exercise (19).

This study has some limitations. First the small sample size. Second the inability to do the study in double blind technique. Third, the short-term follow-up. However, because many other researches on the subject use a comparable time range, we feel that three months of follow-up is sufficient to determine short-term therapy benefits.

Lastly, it would be better to perform Constant-Murley scale and quality of life questionnaire. So, more future studies on these scales are recommended to support our results.

CONCLUSIONS

This study provides evidence that both intra-articular steroid injection and hyaluronic acid are safe, effective and well tolerated treatment for patients with frozen shoulder. The addition of SSNB adds more benefit for both methods of injection.

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DATA AVAILABILITY

Data are available under reasonable request to the corresponding author.

CONTRIBUTIONS

AM, ME: study design and conceptualization. EM and ME: data collection and analysis. All authors: writing, revision and approval of the article.

CONFLICT OF INTERESTS

The authors declare that they have no conflict of interests.

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