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SHOULDER

Subclinical hypothyroidism and diabetes as risk factors for postoperative stiff shoulder

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Abstract
Purpose Postoperative stiffness can be a disabling condition after arthroscopic shoulder surgery. The purpose of this study was to analyse the potential contribution of subclinical forms of hypothyroidism and diabetes in the development of postoperative shoulder stiffness.
Methods A prospective study was conducted on 65 consecutive patients scheduled for arthroscopic subacromial decompression or rotator cuff tear repair. Patients with preoperative stiffness were excluded. Preoperative measurements of free thyroxine, free triiodothyronine, thyroid-stimulating hormone and fasting glycaemia were taken in all patients to detect subclinical forms of diabetes and hypothyroidism. A follow-up was planned at 30, 60, 90 and 180 days after surgery. According to range of motion measurements, postoperative stiffness was classified as severe or moderate at follow-up. Univariate and logistic regression analyses were performed for the assessment of risk factors for stiffness.
Results The overall incidence of postoperative stiffness was 29 % (19/65) in our cohort. Considering only the arthroscopic rotator cuff repairs, this incidence was 23 % (7/31). A new diagnosis of subclinical forms of diabetes or hypothyroidism was made in five cases. All five of these cases developed postoperative stiffness. The logistic regression analysis demonstrated that hypothyroidism was a risk factor for severe stiffness (RR = 25; $p = 0.001$) and that diabetes was a risk factor for moderate stiffness (RR = 5.7; $p = 0.03$).
Conclusion The postoperative stiffness in the majority of patients can be predicted by a careful analysis of past medical history and by detecting subclinical forms of hypothyroidism and diabetes.
Level of evidence Prognostic study, Level II.

Keywords Hyperthyroidism · Diabetes · Arthroscopy · Risk factors · Subacromial decompression · Rotator cuff tear repair · Stiff shoulder

Introduction

Postoperative stiffness can be a disabling condition after arthroscopic shoulder surgery. This condition has been reported to affect 2.8–23 % of the patients after rotator cuff tear repair, depending on the study design and the criteria used to define stiffness [4, 5, 13, 17, 20].

Although several causes have been suggested to increase the risk of postoperative stiffness, including hormonal dysfunction, young age, partial supraspinatus tear and procedures involving the labrum, we are far from being able to predict which patients will eventually develop shoulder stiffness [13, 14]. This is even more frustrating considering that, in some cases, stiffness complicates surgeries in apparently healthy patients who underwent relatively minor arthroscopic procedures. In these patients, the incidence of postoperative stiffness seems to be unpredictable and leads to unsuccessful outcomes at short-term and medium-term follow-up.

Among all the possible factors that can cause postoperative stiffness, recently our interest has been focused on

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hormonal dysfunction. Hypothyroidism or diabetes has been observed by the authors in patients with no apparent history of endocrine disorders within a few years of arthroscopic shoulder surgery complicated by stiffness. This suggested that some subclinical hormonal disorders were already present at the time of surgery, without being diagnosed, and could justify unexplained cases of postoperative stiffness.

In light of this observation, the aim of this prospective study was to analyse the potential contribution of subclinical forms of hypothyroidism and diabetes in the development of postoperative shoulder stiffness.

To our knowledge, no prior studies have focused on the potential association between postoperative shoulder stiffness and subclinical forms of these two diseases. This information has the potential to provide the physician with an important instrument for a better counselling the patient, as well as suggesting prophylactic measures for patients at high risk of postoperative stiffness.

Materials and methods

From 2012 to 2014, a prospective study of shoulder patients at our institution was conducted. All the patients scheduled for arthroscopic subacromial decompression or rotator cuff tear repair were considered eligible for the study.

Patients with preoperative shoulder stiffness, defined as passive external rotation with the elbow at the side (ER1) of less than 30° or passive elevation in scapular plane of less than 130° were excluded. Patients with associated glenohumeral osteoarthritis were also excluded. In order to exclude patients with a potentially undiagnosed idiopathic adhesive capsulitis in the freezing or painful stage (a condition that can simulate a subacromial impingement [11, 16, 19]), we excluded patients with less than 6 months of shoulder symptoms with the exception of patients with a recent diagnosis of posttraumatic rotator cuff tear. All the patients included in the study underwent conservative treatment for at least 3 months before surgery. A shoulder and elbow surgeon (DB) made the diagnosis, suggested the surgical treatment and collected the baseline preoperative Oxford Shoulder Score (OSS) [7], Constant Score (CS) [6], Subjective Shoulder Value (SSV) [10] and level of pain (assessed in a visual analogue scale—VAS—with 0 corresponding to the absence of pain and 10 unbearable pain). All the patients had an MRI before surgery to confirm the diagnosis. Patients were also assessed before surgery by a trained researcher (FF), not involved in the surgical treatment, who collected the required data for the study.

The following preoperative variables and scores were collected: age, gender, arm dominance, active and passive range of motion (ROM) in the affected and the opposite shoulder, OSS, CS, SSV and VAS. Information regarding medical disorders was carefully investigated with particular attention to diabetes, pre-diabetes conditions and thyroid dysfunction. Patients with impaired fasting glucose (fasting plasma glucose level from 110 to 125 mg/dL) and/or impaired glucose tolerance (2-h glucose levels of 140–199 mg/dL on the 75-g oral glucose tolerance test) were considered to have a pre-diabetic condition [1]. Patients were considered to have a thyroid dysfunction if they declared a clear diagnosis of thyroid dysfunction (chronic or transitory) or if a diagnosis of subclinical hypothyroidism was made over the course of the study. In addition to the routine preoperative blood tests, all the patients included in the study underwent a blood measurement of free thyroxine (fT4), free triiodothyronine (fT3), thyroid-stimulating hormone (TSH) and fasting plasma glucose. This was done for the purpose of detecting subclinical forms of hypothyroidism and diabetes. Subclinical hypothyroidism was defined as an increased level TSH with normal fT3 and fT4 [8].

The dimension of the rotator cuff tear, the type of long head of the biceps (LHB) procedure (nothing or tenotomy) and the presence of calcific deposits were the independent variables collected at the time of surgery.

After surgery, no drain was used. A shoulder sling without an abduction pillow was used by all the patients; follow-up was conducted at our institute following a standardized postoperative rehabilitation programme.

The rehabilitation protocol depended on the surgery. The patients who underwent subacromial bursectomy, LHB tenotomy and acromioplasty were instructed to remove the shoulder sling as soon as tolerated and to start pendulum exercises immediately after surgery. Simple home exercises were shown and an information brochure was given to the patients with illustrations explaining those exercises. Between 2 and 3 weeks after surgery, an outpatient follow-up was scheduled with a physiotherapist to identify and correct early problems. For these patients, no formal outpatient-assisted rehabilitation protocol was prescribed.

Patients who underwent rotator cuff tear repair were asked to wear the sling for 4 weeks and to progressively remove the sling in the subsequent 2 weeks. Pendulum exercises were started immediately after surgery. Patients commenced an outpatient-assisted rehabilitation protocol 4 weeks after surgery starting with passive rehabilitation followed by active assisted rehabilitation at 6 weeks after surgery. Unless differently prescribed by the orthopaedic surgeon, the physiotherapy ended approximately 3 months after surgery.

At 30, 60, 90 and 180 days after surgery, patients were evaluated by a shoulder and elbow specialist who measured active and passive ROM (using a manual goniometer), OSS, CS (starting at 90 days of follow-up), subjective

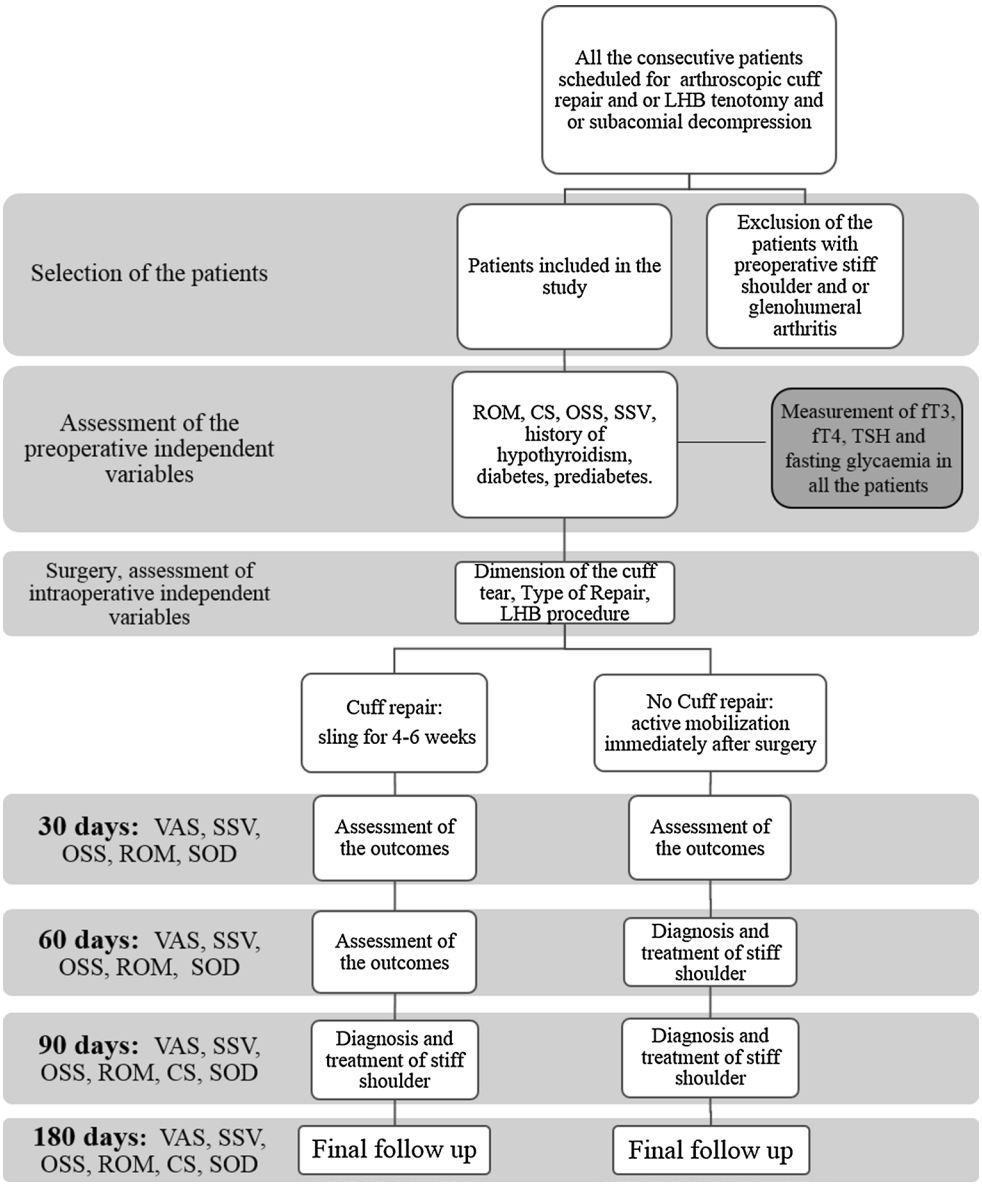

Fig. 1 Flowchart that summarizes the main features of the study protocol. *VAS* visual analogue scale for pain, *SSV* Shoulder Subjective Value, *OSS* Oxford Shoulder Score, *ROM* Range of Motion, *CS* Constant Score, *SOD* Subjective Outcome Determination, *LHB* long head of the biceps

outcome determination (SOD) score [3, 9] and SSV. The SOD score is an entirely subjective score that grades the outcome from "worse than before surgery" (−3) to "normal shoulder" (10 points). The SSV score grades the outcome as a rate of a subjectively normal shoulder, with outcomes range from 0 to 100 %.

The examiner was blinded to the laboratory tests of the patient and to the past medical history.

Severe stiffness was defined as passive external rotation with the elbow at the side (ER1) of less than or equal to 10° [4]. When passive ER1 was >10° but the passive abduction or elevation was measured to be less than or equal to 130°, the stiffness was classified as moderate.

This definition of stiffness was modified from the original definition of Brislin et al. [4] and applied starting at 2 months post-op in patients who underwent subacromial decompression and starting at 3 months post-op in patients who underwent rotator cuff tear repair.

Patients diagnosed with severe postoperative stiffness were treated with an intra-articular injection of 40 mg of methylprednisolone acetate (Depo Medrol®) and by increasing the amount of physiotherapy. The injection was performed without ultrasound control using an injection site corresponding to the anterior arthroscopic portal.

Patients with moderate stiffness were treated only with an increase in the amount of physiotherapy. The study protocol is summarized in Fig. 1. The patients with a stiff shoulder complication were followed monthly once diagnosed and the treatment started.

In light of the Italian law, no IRB approval is required for this type of study. However, each author certifies that his or her institution has approved the human protocol for this

investigation and that all investigations were conducted in conformity with ethical principles of research.

Statistical analysis

A univariate analysis was carried out by calculating the relative risk (RR) for each potential risk factor (age, gender, diagnosis, arm dominance, duration of symptoms before surgery, diabetes and pre-diabetes, hypothyroidism and subclinical hypothyroidism, other comorbidities, LHB procedure). The rates of severe stiff shoulder and moderate stiff shoulder were considered the dependent variables of the study. The most relevant independent factors ($p < 0.1$) were included in a logistic regression analysis. MedCalc Software (MedCalc Software bvba, Ostentd, Belgium) was used for the analysis of the data. Student t and Fisher tests were used for comparisons of the average values between groups. A power analysis to calculate a minimum number of patients to be included in the study was not performed because information regarding the rate of patients with pre-diabetes conditions and subclinical hypothyroidism was not available in the literature for patients undergoing shoulder arthroscopy. Based on initial resource estimates, the enrolment goal for this study was 75 patients.

Results

Sixty-five patients out of 75 completed the entire study protocol. Of the 65 patients, 37 were females. The mean age was 55 ± 9 (range 37–74). Thirty-one patients had a diagnosis of rotator cuff tear (25 patients with supraspinatus tears, 6 with both supraspinatus and infraspinatus tears), 10 were affected by calcific tendinobursitis, and 24 were affected by subacromial tendinobursitis. The mean duration of symptoms before surgery was 17 months. The mean preoperative values were: CS 53 ± 13, SSV 51 ± 14, OSS 26 ± 7, VAS for pain 6 ± 2, abduction 124° ± 41°, elevation 140° ± 34°, external rotation with the elbow at the side (ER1) 41° ± 18°, external rotation with the elbow at 90° of abduction (ER2) 57° ± 28° and internal rotation with the elbow at 90° of abduction 49° ± 28°.

All the rotator cuff tears had a single row repair (for 4 cases, only a partial suture was achieved). Partial rotator cuff tear lesions (PASTA) were not addressed surgically and were included in the tendinobursitis group. Fifty patients had a LHB tenotomy. Seven patients did not adhere to the rehabilitation programme. Five of them did not attend any rehabilitation (two out of five underwent rotator cuff tear repair). None of these patients developed postoperative stiffness.

Twelve patients (18 %) were classified as affected by diabetes/pre-diabetes: 7 patients (11 %) had a positive medical history of symptomatic diabetes, and 5 presented with a pre-diabetes condition (8 %). Of the patients with pre-diabetes, 2 had a new diagnosis of impaired fasting glucose, revealed during the preoperative exams. Twelve patients (18 %) were affected by hypothyroidism: 3 (5 %) new diagnosis of subclinical hypothyroidism, 2 (3 %) previous diagnosis of transitory hypothyroidism (but patients did not take hormonal replacement therapy) and 7 (11 %) previous diagnosis of hypothyroidism (all Hashimoto's disease under treatment). One patient, among the 24 patients described, was affected by both diabetes and a subclinical hypothyroidism.

The incidence of postoperative stiffness was 29 % (19/65) in the entire cohort, 23 % (7/31) in the subgroup of arthroscopic rotator cuff repair and 35 % (12/34) in the remaining patients. Eleven patients (17 %) had a diagnosis of severe postoperative stiff shoulder. The diagnosis was made at the 60th day of follow-up in 10 patients who underwent subacromial decompression and at the 90th day after surgery in one patient who underwent a repair of a full-thickness supraspinatus tear. At the time of the diagnosis of severe stiffness, the average VAS score for pain was 7 ± 2 (Fig. 2) compared to the value of 3 of VAS for patients without complications ($p < 0.001$). Eight patients (12 %) showed moderate postoperative stiffness. The diagnosis was made at 90 days postoperatively in 5 patients treated for a full-thickness tear. In 3 patients who underwent subacromial decompression, the diagnosis was made at 60 days of follow-up. The VAS score for pain was 3.5 at the time of diagnosis of stiffness (p = n.s.). No patients affected either by severe or moderate postoperative stiffness underwent revision surgery.

The univariate analysis of the risk factors for severe stiffness is reported on Table 1. Using the logistic regression analysis, only patients in the hypothyroidism group were at risk of developing postoperative severe stiffness (RR = 25, $p = 0.001$). Of the 12 patients who had thyroid dysfunction, 9 (75 %) developed postoperative stiffness (8 severe and one moderate). The univariate analysis of the risk factors for moderate stiffness is reported in Table 2. Using the logistic regression analysis, only diabetes was found as a significant risk factor (RR = 5.7, $p = 0.03$) for moderate stiffness. Of the 12 patients who had diabetes or showed pre-diabetes conditions, 5 (42 %) developed postoperative stiffness (4 moderate and 1 severe). The patient who had severe stiffness has also a subclinical hypothyroidism.

Of the 9 patients who were not under hormonal replacement therapy, 6 had postoperative shoulder stiffness (67 %), whereas 7 patients (50 %) experienced stiffness of the 14 patients under hormonal replacement therapy (p = n.s.). Among the 46 patients who did not declare any hormonal dysfunction in their past medical history, 5 (11 %) patients with a new diagnosis of a pre-diabetes condition (2 patients) or subclinical hypothyroidism (3 patients) were detected. All 5 of these patients developed postoperative

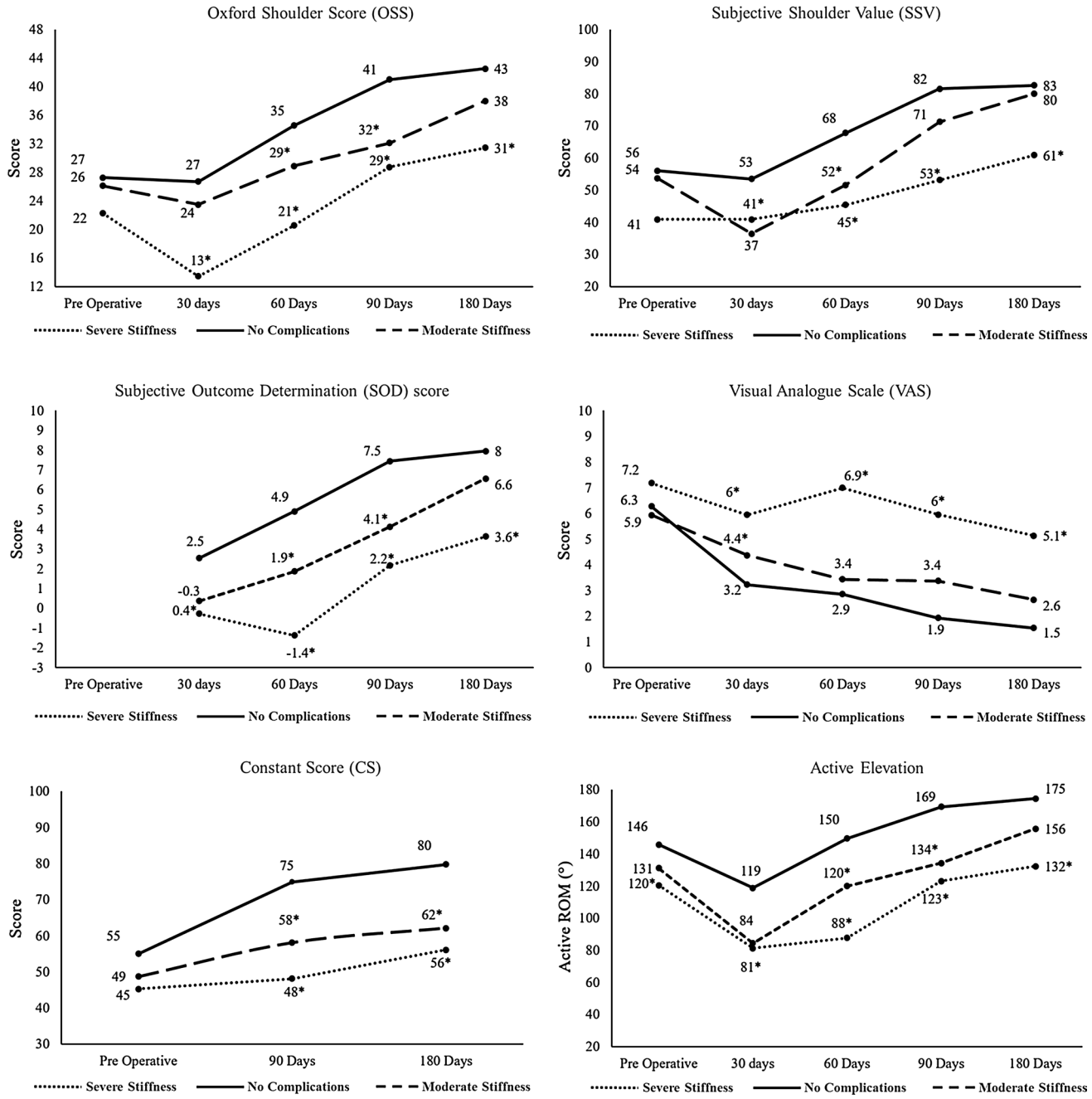

Fig. 2 Summary of the most relevant outcomes. Patients with severe stiffness improved in ROM, VAS, CS, OSS and SSV after the injection. At 180 days after surgery, all the measured outcomes were significantly different between complicated and patients without complications. At 180-day follow-up, the results were similar to the patients without complications, except for the CS which was significantly worse in the stiff shoulder patients (62 vs. 80, $p = 0.03$). *VAS* visual analogue scale for pain, *SSV* Shoulder Subjective Value, *OSS* Oxford Shoulder Score, *ROM* Range of Motion, *CS* Constant Score, *SOD* Subjective Outcome Determination. *$p < 0.05$, with respect to patients without complications

shoulder stiffness. The patients who had a severe postoperative stiffness improved after intra-articular injection of methylprednisolone acetate. The injection was performed at the moment of the diagnosis of stiffness.

The details of the outcomes are reported in Fig. 2.

Discussion

The most important finding of the present study is that subclinical hypothyroidism and diabetes resulted in significant risk factors for stiffness.

Table 1 Univariate analysis of the risk factors for occurrence of severe postoperative stiffness

Variables	*n*	Cases with severe stiffness	Cases without severe stiffness	RR	*p* value
Hypothyroidism	**12**	**8**	**4**	**11.8**	**<0.001**
Cuff tear repair	**31**	**1**	**30**	**0.1**	**0.03**
Calcific tendinosis	**10**	**4**	**6**	**3.1**	**0.03**
Gender (female)	**37**	**10**	**27**	**7.6**	**0.04**
Involvement of supraspinatus only	25	1	24	0.2	n.s.
LHB tenotomy	50	7	43	0.5	n.s.
Surgery dominant arm	49	7	42	0.6	n.s.
Diabetes	12	1	11	0.4	n.s.
Other pathologies	19	2	17	0.5	n.s.
No compliance to physiotherapy	5	0	5	0.4	n.s.
Cuff tear partially repaired	4	0	4	0.5	n.s.
Smoke	19	3	16	0.9	n.s.
		Average	Average	RR	*p*
SSV (%)		**41**	**56**	**0.91**	**0.001**
Delayed of surgery (months)		**26**	**16**	**1.05**	**0.02**
Elev (°)		**131**	**146**	**0.98**	**0.03**
ABD (°)		**99**	**130**	**0.98**	**0.03**
Constant Score		**42**	**55**	**0.97**	**0.04**
Age		52	56	0.95	n.s.
ER1 (°)		40	49	0.97	n.s.
ER2 (°)		40	57	0.97	n.s.
IR2 (°)		41	53	0.99	n.s.

SSV Subjective Shoulder Value, *ABD* abduction, *ER1* passive external rotation with the elbow at side, *ER2* passive external rotation with the arm in the throwing position, *IR2* passive internal rotation with the arm in the throwing position. In bold are variables with $p < 0.05$

Patients with hypothyroidism were 25 times more likely to undergo surgery and showed complications such as severe reduction in ROM and prolonged pain. Of the 12 patients who were positive for any form of hypothyroidism, 9 developed postoperative stiff shoulder, which made stiffness predictable in 75 % of cases. Such a high proportion was not expected.

Several explanations could explain why this strong association was not reported before. First, most of the available papers on postoperative stiffness have focused on rotator cuff tear repair. Among the 19 patients who developed postoperative stiffness in our series, only 5 had undergone a rotator cuff tear repair. In the retrospective study of Huberty et al. [13] on 489 arthroscopic rotator cuff repairs, the incidence of postoperative stiffness was 5 % and a correlation with hormonal dysfunction was not found. However, in contrast to our study, only the patients who required a second surgery to treat stiffness were considered as having this complication: this could explain the higher rate of complication in our study. Similarly to our study, Chung et al. [5], in a retrospective analysis of rotator cuff tear repair, defined stiffness by measuring the ROM at follow-up. They found an incidence of stiff shoulder at 3 months of 19 % similar to the rate that we observed in the subgroup of patients who had undergone a rotator cuff repair. Unfortunately, that study did not consider thyroid dysfunction as potential risk factor for stiffness.

Another reason is the retrospective design of the available studies, with the consequent potential loss of patients affected by subclinical forms of diabetes and hypothyroidism. In our study, among the 19 patients who developed stiffness, 7 (37 %) did not take hormonal therapy at the time of surgery. These patients would probably not have been recognized as affected by hormonal diseases in a retrospective study.

Another potential source of disagreement between our findings and previous studies could be the definition of postoperative stiffness. Part of the definition described by Brislin et al. [4] using the passive external rotation with the elbow at the side was adopted. We used this parameter because we believe it is reproducible. In contrast to other studies, we did not consider only stiffness that required a revision surgery. Moreover, considering that stiffness is a spectrum of symptoms more than a single entity, we

Table 2 Univariate analysis of the risk factors for occurrence of moderate postoperative stiffness

Variables	*n*	Cases with moderate stiffness	Cases without stiffness	RR	*p* value
Diabetes	**12**	**4**	**8**	**4.4**	**0.02**
Surgery dominant arm	49	7	42	0.3	n.s.
Involvement of supraspinatus only	25	5	20	2.7	n.s.
Other pathologies	19	0	19	0.13	n.s.
Cuff tear repair	31	5	26	1.8	n.s.
Calcific tendinosis	10	0	10	0.3	n.s.
LHB tenotomy	50	7	43	2	n.s.
No compliance to physiotherapy	5	1	4	1.8	n.s.
Hypothyroidism	12	1	11	0.6	n.s.
Gender (female)	37	5	32	1.26	n.s.
Cuff tear partially repaired	4	0	4	0.7	n.s.
Smoke	19	2	17	0.9	n.s.
		Average	Average	RR	*p*
Age		60	56	1.07	n.s.
ER2 (°)		68	57	1.01	n.s.
ER1 (°)		39	49	0.97	n.s.
IR2 (°)		39	53	0.99	n.s.
Constant Score		49	55	0.97	n.s.
Delayed of surgery (months)		14	16	0.96	n.s.
Elev (°)		131	146	0.99	n.s.
SSV (%)		54	56	1	n.s.
ABD (°)		125	130	1	n.s.

SSV Subjective Shoulder Value, *ABD* abduction, *ER1* passive external rotation with the elbow at side, *ER2* passive external rotation with the arm in the throwing position, *IR2* passive internal rotation with the arm in the throwing position. In bold are variables with $p < 0.05$

decided to stratify stiffness in two groups according to the severity of the lack of motion. This decision was taken since not all the patients affected by clinically significant loss of motion have the same clinical manifestations and prognosis.

Two distinctive types of postoperative stiffness were observed. The severe form was typically seen after subacromial decompression. In addition to the loss of motion in external rotation, they also had severe pain, loss of motion in the entire axis of movement and, above all, poor clinical outcomes. This subgroup of postoperative stiffness had clinical features similar to those of idiopathic adhesive capsulitis [11, 16, 19], including the association with thyroid disease as a risk factor [12, 15]. The clear similarities between severe postoperative stiffness and idiopathic adhesive capsulitis made us ask ourselves whether the majority of the cases that developed postoperative stiffness were actually idiopathic adhesive capsulitis with an incorrect diagnosis of tendinobursitis. Although possible, this situation is rather unlikely because the ROM was measured accurately in all the patients before surgery (and intra-operatively) with the specific goal of avoiding the inclusion of patients with idiopathic adhesive capsulitis in the studied population. Moreover, the average length of symptoms before surgery was 26 months in the patients who developed severe postoperative stiffness. This factor, in theory, excludes patients in the first stage of the idiopathic adhesive capsulitis, a condition that usually lasts only for a few months. A possible explanation for the similarities between severe postoperative stiffness and adhesive capsulitis could be that the surgery or the rehabilitation protocol acts as trigger event, in predisposed patients, for the development of a severe inflammation of the capsule. This could also explain the benefits that the patients had after intra-articular injection of cortisone, which has also been reported as successful in patients with adhesive capsulitis [2, 18]. The strong association between hypothyroidism and severe stiff shoulder does not automatically prove that it causes stiffness: we cannot exclude a third factor in common between stiffness and hypothyroidism, such as, an autoimmune reaction (all the patients with a previous diagnosis of hypothyroidism were affected by Hashimoto's disease).

A smaller number of patients in our series developed a moderate postoperative stiffness. Interestingly, diabetes and

not hypothyroidism was found to be the major risk factor of this minor complication. This suggests that the aetiologies of severe and moderate stiffness are different. The patients with moderate stiffness, at the time of diagnosis, were characterized by a less severe limitation of ROM and by a level of pain similar to the one usually observed 2–3 months after surgery. Compared to the severe stiffness group, these patients had a better prognosis with improvement overtime and a tendency to reach the level of outcomes of patients without complications. Another finding that could support the hypothesis that the two forms of stiffness are two distinctive entities is the correlation between rotator cuff tear repair and stiffness. While in the severe stiffness group, a rotator cuff tear repair seemed to be protective against severe stiffness, in the moderate stiffness group, a rotator cuff tear repair, especially in case of a small supraspinatus tear, seemed to increase the risk of stiffness. Other studies have analysed the association between dimension of the rotator cuff tear and postoperative stiffness. In the study of Huberty et al. [13], a small rotator cuff tear seemed to increase the risk of postoperative shoulder stiffness. On the contrary, Chung et al. found that larger rotator cuff tear increased the risk of postoperative stiffness [5]. The reason of this disparity is not known, but could be related to the different definitions used for postoperative stiffness.

This study has clear limitations. One of the main limitations is the definition of stiffness that has been used: the passive ROM measured at follow-up was preferred to the occurrence of revision surgery for stiffness because we believe it is more reproducible and does not underestimate the rate of stiffness. Another limitation is the short follow-up. Patients were followed up prospectively for 6 months. However, this decision was made since our primary goal was to analyse the correlation between the onset of postoperative stiffness and hormonal dysfunction. The diagnosis of postoperative stiffness is usually made around 3 months after surgery [5, 20]: a follow-up of 6 months was therefore considered enough to avoid missing cases. Another potential source of bias could be the extreme attention that we put on the diagnosis of any thyroid dysfunction and diabetes. This could have influenced the outcome by overestimating the correlation between these diseases and stiffness, while other factors could have been underestimated. Another limitation is that we have not taken into account risk factors such as body mass index and hypercholesterolaemia.

Nevertheless, this study strongly suggests that a better analysis of the preoperative clinical and subclinical forms of diabetes and hypothyroidism will give the surgeon an important instrument for better counselling the patient, because of the increased ability to predict which patients will develop stiffness. For this reason, we suggest measuring fT3, fT4, TSH and fasting glycaemia in all patients scheduled for subacromial decompression or rotator cuff tear repair. Patients with a new diagnosis of hypothyroidism or diabetes should be informed of the high risk of developing postoperative shoulder stiffness.

Future studies could assess whether postoperative stiffness could be avoided in patients at high risk for developing this complication by adopting prophylactic measures such as early treatment with oral corticosteroid, dedicated postoperative rehabilitation protocols or a surgical opening of the rotator interval. Moreover, further studies could assess whether patients at high risk for postoperative stiffness who underwent subacromial decompression without rotator cuff repair may benefit from early postoperative injection therapy.

Conclusion

Subclinical hypothyroidism and diabetes seem to be risk factors for severe and moderate stiffness, respectively. The surgeon should carefully investigate these comorbidities before surgery. Measurement of fT3, fT4, TSH and fasting glycaemia in all the patients scheduled for subacromial decompression or rotator cuff tear repair provides important information to better counsel the patient of their postoperative shoulder stiffness risk.

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