Original Article

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Evaluation of Complications of Shoulder Arthroscopy in the Treatment of Sub acromial Pathologies

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Abstract

Objectives: To analyze the prevalence of complications of arthroscopic shoulder surgery for the treatment of sub acromial pathologies and verify if it is affected by sex, age, obesity, smoking habit or by the surgeon's learning curve.

Methods: from Aug 2001 to Oct 2017, 1322 shoulders were treated for sub acromial pathologies by arthroscopic technique. One surgeon operated all the cases of subacromial pathologies. Exclusion criteria were revision surgeries and insufficient medical records, resulting in a total of 1246 patients.

Results: The analysis of the sample showed a significant predominance ($p<0.0001$) of the female patients (60.5%). The group of female patients had the highest age ($p<0.001$). There were complications in 197 patients. The prevalence of complications was 15.8%. Analyzing the female patients separately, a prevalence of complications of 16.5% was verified, while the male patients had 14.8% ($p=0.432$). Statistical analysis showed a higher prevalence of complications in younger patients ($p=0.036$). Obese patients (25.8% of the sample) had 13.4% of complications, while non-obese patients had 16.7% ($p=0.161$). The analysis of complications according to smoking habits did not show a higher prevalence of complications when comparing smokers and nonsmokers ($p=0.492$). The most frequent complication found in the study was stiffness, with 63 cases (32.5% of the complications). We found 36 cases of stiffness (6.3%) in the immobilized group with a common sling, while the immobilized group with a neutral rotation cushion of the MS presented 27 cases of stiffness (4%). The reduction of 2.3% with the use of sling in neutral rotation was not considered significant ($p = 0.066$). We analyzed the first 400 arthroscopic cases with the last 400 cases operated. 20.8% of complications were found in the first 400 cases operated and 10.5% in the last 400 cases ($p<0.001$).

Conclusion: The prevalence of complications of arthroscopic shoulder surgery for the treatment of sub acromial disorders was 15.8%. It was not possible to demonstrate sex, obesity and smoking as risk factors for shoulder arthroscopy complications. It was possible to demonstrate that the age under 65 years and the surgeon's learning curve significantly affect the prevalence of complications after shoulder arthroscopy.

Keywords: shoulder, arthroscopy, complications.

Introduction

Arthroscopy is a method of diagnosis and treatment that has as its main characteristic the low aggression caused to the joint. The constant evolution of the instruments available to the surgeon and surgical techniques led to arthroscopy being the most commonly performed surgical orthopedic procedure in the United States (1). In the shoulder joint is considered a safe procedure (2), in addition to the low shoulder aggression, the lower postoperative pain, arthroscopy collaborates for a quick return to professional and daily activities. Because it is a technique that requires a long learning curve, the complications of arthroscopy cannot be disregarded.

The learning curve of arthroscopic triangulation was studied by several authors (3,4,5,6,7). Dal Molin et al. (3) evaluated the learning of the arthroscopic technique in Orthopedic residents using the SAM® (Shoulder Arthroscopy Model) synthetic simulator. Alvand et al. (4) investigated the innate qualities of the individual for the arthroscopic technique, concluding that, even with adequate training, there is a difference in the ability of the surgeon to develop the arthroscopic technique. Regardless of the way the studies are conducted, the need for a progressive evolution of arthroscopic learning is clear (4,5,6,7). Along the learning curve, the surgeon is subject to the most varied complications and has the

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challenge of preserving patient safety (1,6,8,9).

The aim of this study is to analyze the prevalence of complications of arthroscopic shoulder surgery for the treatment of sub acromial disorders. A secondary objective is to determine whether gender, age, obesity, smoking, and surgeon's learning curve can be considered as risk factors for complications.

Method

The study was retrospectively and endorsed by the Ethics Committee through data analysis in the Brazil Platform.

In the period from August 2001 to October 2017, a total of 1322 shoulders were operated through the arthroscopic technique for sub acromial pathologies, by the surgeon in charge of the service.

During the surgical treatment, general anesthesia preceded by interscalene blockade was used in 743 cases. Isolated general anesthesia was an option in 579 cases, and these patients used a sub acromial epidural catheter of continuous analgesia for 24 hours postoperatively.

The patients were placed in lateral decubitus with a discrete fall of the trunk to posterior and the upper limb (UL) in traction of 5 kg with flexion of 20° and lateral abduction of 30°. Arthroscopy was performed with 30° angulation optics.

All patients were a simple sling for 15 days in cases where no tendon suture was performed. When suturing of the cuff was performed, a sling with an abduction cushion was used until November 2010. From December 2010, a sling with a neutral rotation pad of the UL was routinely used.

The pathologies included in this study were suturing or debridement of one or more tendons of the rotator cuff of the shoulder, acromioplasty, resection of the distal end of the clavicle, and treatment of calcific tendonitis.

Exclusion criteria were revision surgeries (66 patients) and insufficient medical records (10 patients), resulting in a total of 1246 patients for analysis.

The mean age of the patients included in the study was 54 ± 9.2 years. Regarding gender, 753 patients were female (60.5%) and 493 patients were male (39.5%). The right side was affected in 892 patients (71.6%). The dominant side was affected in 922 patients (74%).

The studied variables were: age, sex, operated side, dominance, smoking habit, degree of obesity and prevalence of complications.

The data were analyzed by the IBM SPSS 22.0 statistical package. When the data were normally distributed, they were expressed by the mean and standard deviation; when they were asymmetrical, the median and the interquartile range (IIQ) were used. In the comparison of the proportions found, the Chi-square test (Fisher's exact test) and their respective 95% confidence intervals were used. Statistical tests were bilateral and p<=0.05 was considered statistically significant.

Results

The analysis of the sample showed a significant predominance (p<0.0001) of the female patients (753 cases - 60.5%).

The mean age was analyzed for male and female patients. Male patients had a mean age of 52.3 ± 11 years, while female patients had a mean age of 56 ± 10.2 years. The highest age of female patients was statistically significant (p<0.001).

There was a higher frequency of surgeries on the right side in both male patients (70.6%) and female patients (72.2%). There was no statistical predominance for the right side between the sexes (p=0.526). The predominance of the right side on the left side was considered significant (p<0.0001).

There was a higher frequency of surgeries on the dominant side in both male patients (73%) and female patients (74.6%). There was no statistical predominance for surgery on the dominant side between the sexes (p=0.526). The predominance of the dominant side on the non-dominant side was considered significant (p<0.0001).

There were complications in 197 patients. The prevalence of complications was 15.8% (95% CI: 13.8% - 17.8%). Table 1.

Analyzing the female patients separately, a prevalence of complications of 16.5% (124 cases) was verified, while the male patients had 14.8% (73 cases). The difference was not considered significant (p=0.432).

The analysis of complications according to the patient's age group was performed comparing patients below 65 years with patients from 65 years of age. Patients younger than 65 years (1015 cases) had 16.8% of complications, while patients aged 65 and over (231 cases) had 11.3%. Statistical analysis showed a higher prevalence of complications in younger patients

Table 1: Characteristics according to sex

Characteristic	Female	Male	*P*
	n = 753	n = 493	
Sex – % ($IC_{95\%}$)	60,4 (57,7 a 63,1)	39,6 (36,9 a 42,3)	< 0,0001
Age in years – average (sd[1])	56,0 (10,2)	52,3 (11,0)	<0,001
Age ≥ 65 years – % ($IC_{95\%}$)	22,4 (19,5 a 25,4)	12,6 (9,6 a 15,5)	< 0,0001
Dominant Side – % ($IC_{95\%}$)	746 (71,5 a 77,7)	73,0 (69,1 a 76,9)	0,526
Right Side – % ($IC_{95\%}$)	70,6 (66,6 a 74,6)	72,2 (69,0 a 75,4)	0,526
Complications – % ($IC_{95\%}$)	16,5 (13,8 a 19,1)	14,8 (11,7 a 17,9)	0,432
[1]sd = standard deviation			

Table 2: Characteristics according to nutritional state

OBESITY	Obese	Non Obese	*P*
	n = 322	n = 923	
Complications – % ($IC_{95\%}$)	13,4 (9,6 a 17,1)	16,7 (14,3 a 19,1)	0,159

Table 3: Characteristics according to smoke habit

Smoke Habit	Smokers	Nonsmokers	*P*
	n = 311	n = 394	
Complications – % ($IC_{95\%}$)	17,0 (12,9 a 21,2)	15,4 (13,1 a 17,7)	0,497

Table 4: Learning Curve

	Initial Faze	Final Faze	*P*
	n = 400	n = 400	
Complications – % ($IC_{95\%}$)	20,8 (16,8 a 24,7)	10,5 (7,5 a 13,5)	0,0001

(p=0.036). The analysis was considered significant.

The analysis of the complications according to the degree of obesity measured by the Body Mass Index (BMI) of the patients was performed by grouping the patients with BMI below 30 (normal and overweight) and comparing them with patients with BMI from 30 (grade 1, 2 and morbid obesity). Obese patients (322 cases - 25.8% of the sample) had 13.4% of complications, while non-obese patients (924 cases) had 16.7%. The higher frequency of complications in non-obese patients was not considered significant (p=0.159). Table 2.

The most frequent complication found in the study was stiffness, with 63 cases corresponding to 32.5% of the complications.

The analysis of the prevalence of stiffness was performed according to the type of postoperative immobilization used. A total of 572 cases were operated before December 2010, where the sling used was common or a sling with an abduction cushion, with 674 cases operated after that date that used a sling with immobilization cushion in the neutral position of the UL. We found 36 cases of stiffness (6.3%) in the immobilized group with a common sling or a sling with an abduction cushion, while the immobilized group with a neutral rotation cushion of the UL presented 27 cases of stiffness (4%). The reduction of 2.3% with the use of sling in neutral rotation was not considered significant (p=0.066).

We analyzed the first 400 arthroscopic cases with the last 400 cases operated. 20.8% of complications were found in the first 400 cases operated and 10.5% in the last 400 cases. The finding was considered significant (p<0.001). Table 4.

Discussion

The option for arthroscopic treatment of shoulder disorders, as well as obvious advantages over open procedure, has been growing significantly in the last two decades due to advances in technology, surgical techniques and knowledge of the complex anatomy of the joint (1,10). In the case of the treatment of subacromial disorders, the main advantages cited are: the less aggression to the deltoid muscle, the less postoperative discomfort and the possibility of a faster recovery (11,12).

The complication rate of arthroscopic shoulder surgery is less than that of open surgery (1,13,14), but there is great difficulty in discussing the complications reported in the literature. Some authors evaluate their casuistry in different ways and the published works are often case reports or series of cases.

Regarding the different ways of evaluating a casuistry, some authors consider only intra- or extra-articular procedures (1); others, as in our study, consider only subacromial procedures. There are authors who deliberately exclude anesthetic complications (9), which are sometimes catastrophic. Some papers subdivide complications arbitrarily into severe, minor, infectious, and specific ones of a particular procedure (1,15,16). Authors such as Shields et al. (16), looking for risk factors for complications, only evaluate those that occur in the first thirty days postoperatively. The investigation of the frequency of complications in the first 30 days in shoulder arthroscopies no longer considers, for example, stiffness as a complication (16). Berjano et al. (17) also did not consider stiffness as a complication in their casuistry.

The rate of complications is also related to the position of the patient during the arthroscopic procedure. Beach chair position is more prone to complications related to cerebral hypovascularisation (9,18,19), while lateral position may lead to neurological complications related to patient accommodation and UL traction (9,18). Airway involvement due to per tracheal infiltration (20,21,22,23) and fluid retention are also mentioned in the lateral decubitus position and are almost non-existent in the beach chair position (18,10,24,24).

A second factor implicated in the difficulty in discussing complications with the literature is the fact that most of what is found are case reports or small series of cases where we are informed about isolated facts and their possible risk factors for onset (1).

Shields et al. (16), investigating risk factors in the first 30 days after shoulder arthroscopy, found a 1% frequency of complications. Berjano et al (17), without considering rigidity as a complication, found 9.49% of complications in their series. Marecek et al. (9) cites that complications of shoulder arthroscopy as rare, varying from 4.6% to 10.6%, and makes it clear that these numbers may be underestimated for two reasons: underreporting of complications and disagreement among surgeons in what to consider a complication. In our study, we considered as complications everything that occurs during treatment available to the patient, from their hospital admission, anesthetic procedures, arthroscopic technique performed, postoperative follow-up for a reasonable time to identify a possible stiffness. The prevalence of complications in our study was 15.8%.

The most frequent complication in our study was stiffness, with 63 cases (5% of the series and 32.3% of the total complications). Stiffness is mentioned in the literature as probably the most frequent complication after any surgical procedure on shoulders (1), and its frequency is even greater in open surgical procedures (12,13). It is reported in the order of 2.8% to 15% after shoulder arthroscopies (1). Despite the efforts of both surgeons and patients, a small portion of the operated shoulders will evolve with joint stiffness, according to Noud and Esch (1). These authors suggest that the best way to minimize stiffness is to inform patients of their manifestation, controlled physiotherapy protocols and frequent postoperative evaluations to early identify the tendency to passive movement loss. In our view, minimizing postoperative pain with analgesics and the correct use of a neutral rotation sling cushion may be added to this list.

Suture dehiscence in the arthroscopic portals was the second most frequent complication in our study with 21 cases (1.68% and 10.8% of the total complications). Although practically harmless and unable to compromise the final result of the treatment, it generates stress in the patient and usually requires a contact between the patient and the surgical team.

The persistence of acromioclavicular pain in the postoperative occurred in 15 cases (1.20% and 7.7% of the total complications). This complication was more frequent in the first years of this series due to the coplaning procedure performed by the author. Over the years, coplaning gave way to total removal of the distal clavicle (Mumford Procedure), generating less acromioclavicular instability (26) and less persistence of postoperative pain (27).

The other complications followed the trend of the literature and were rare, but in some

cases relevant. Pulmonary thromboembolism occurred in 2 cases of our series (0.16%), which is exactly the frequency cited in the literature (2,28,29,30,31,32,33,34). An episode of pneumothorax requiring thoracotomy drainage occurred after interscalene blockade (0.08%). The use of electrical stimulation and, more recently, ultrasonography for the positioning of the blocking needle may lead to a reduction in the potential risk of this complication (35,36,37,38). And an isolated episode of cardiorespiratory arrest in anesthetic induction (0.08%) was also verified. Regarding these three previous citations, it is important to remind patients that even procedures of low aggression to the organism can be associated with significant complications (39).

We verified a case of postoperative deep venous thrombosis (DVT) in the UL (0.08%). This complication is reported as rare in the literature, ranging from 0.06% to 0.42% (2,9,40,41). Martin et al. (2), found 0.09% of DVT in the UL in their series. Regarding DVT in the lower limbs, we found no case. There are no defined guidelines for the use of dynamic compression systems of the lower limbs in the intraoperative period or for immediate postoperative drug prophylaxis in preventing DVT in the lower limbs during shoulder arthroscopy (1,2). Guidance on early ambulation after discharge from the recovery room can avoid this complication.

We did not find any case of deep infection in our series. This serious complication is reported in the literature ranging from 0.16% to 1.9% (2,9,34,42), with Proprionobacterium acnes implicated as the main causative agent (1). Martin et al. (2), found 0.01% deep infection in their series, and 0.16% surface infection. We verified a case of superficial infection (0.08%) that required cleaning and antibiotic therapy.

A case of electro cautery burn in the calf where the malleable plaque with "ground" function (0.08%) was placed forced the treatment with debridement and placement of a skin graft. This devastating complication, mentioned in the literature in isolated cases (43,44,45) of arthroscopy in several joints, required a modification of some criteria in the care of patient positioning in a surgical room.

Due to the lateral decubitus position, we did not find any case of cerebral hypo perfusion and its consequences, more frequently associated with the beach chair position (1,18,19,46,47,48). However, some complications related directly to lateral decubitus position were found: we verified 7 cases (0.56%) of transient neuropraxia of the upper limb reported by the patient. This complication is mentioned in the literature as resulting from the effect of longitudinal traction on the upper limb (18,49,50). All the cases verified became asymptomatic after the months of postoperative follow-up. We also observed 1 case (0.08%) of transient neuropraxia of the contralateral upper limb. We found 3 cases (0.24%) where the extravasation of fluid in the subcutaneous layer reached the per tracheal region and forced a temporary extubation delay with the patient waiting in a inverted trendelemburg position to facilitate the diffusion of the liquid in the subcutaneous. Cited in the literature as a transitory situation, and may become severe with risk of death (18,20,21,22,23,24,25,51). All 3 patients in the study were extubated without complications.

Sex is controversial in the literature with regard to being a risk factor for complications. We found a higher prevalence of complications in females, although this difference was not considered significant. Similar findings were found by Martin et al (2). On the other hand, Heyer et al (53), in a recent study on complications during the first thirty days after the arthroscopic suture of the rotator cuff, identified males as an independent risk factor.

Shields et al. (16), found age greater than 60 years as a significant risk factor for complications in shoulder arthroscopy. In a series of 9410 cases, Martin et al. (2), identified age 65 years as a significant risk factor ($p < 0.002$) for increased complications and mortality after shoulder arthroscopy. In our study, we used the age of 65 years as the cohort point for analysis and we identified, in a significant way, a higher prevalence of complications in patients below 65 years of age. It is possible that the inverse finding of the literature is due to the fact that 81.4% of the study population was in the age range below 65 years of age.

It is reported that one-third of the US population is obese, considering BMI>30 (53). Obesity is considered to be a significant risk factor for joint pain (54,55,56) and is also related to the appearance and severity of rotator cuff lesions (57). The final result of treatment of shoulder tendon lesions in obese patients is generally lower than that of non-obese patients (58). Concerning complications, Sing et al (54), with a percentage of 43% obese in their series, did not find a higher prevalence of complications in obese patients. The same was verified in our study. Martin et al. (2), found a significant ($p<0.048$) BMI>35 as an increased risk factor for severe complications and mortality after shoulder arthroscopy. Analyzing as a separate complication, surgical wound infection, Sing et al (54), identified a statistical relevance, with obese patients presenting a prevalence of 0.3% while non-obese patients, a prevalence lower than 0, 1%. This fact may be related to the characteristic of vascularization and altered immune activity in the skin of the obese (54).

Smoking was identified as a risk factor for complications in the first 30 days of adult patients undergoing shoulder arthroscopy (16). DBPOC, which accompanies some smokers, was considered a risk factor for severe complications and mortality after shoulder arthroscopy (2). Although, in our study, we found a higher prevalence of complications in smokers, this condition was not considered significant.

The literature does not allude to the type of postoperative immobilization as a factor related to the prevalence of complications. Immobilization may lead to higher healing rates of sutured tendons and a tendency to stiffness (59,60), while early mobility leads to a higher incidence of rerupture with less stiffness (59,60,61). In our study, we did not evaluate the rerupture index of the sutured tendons. The comparison of the group of patients immobilized with a common sling presenting 6.3% stiffness with the group of patients immobilized with a sling associated with a neutral rotation cushion of the UL presenting 4% stiffness, showed a reduction of 2.3% although it was not considered significant.

The evolution of the surgeon's learning curve is defined in the literature, especially when procedures that require arthroscopic triangulation are analyzed (4,5,6,7). Guttmann et al. (62), evaluated the evolution of the surgeon's learning curve through the

time elapsed to perform the procedure in his first 100 cases and found a reduction in the duration of surgeries and, consequently, fewer intra and postoperative complications. Martin et al. (2), identified operative time greater than 1.5 hours as a significant predictor for the development of complications. In our series, the analysis of the evolution of the learning curve was performed with temporal criterion. There was a significant reduction in complications with increased surgeon experience ($p<0.001$) with a prevalence of 20.8% of complications in the first 400 operated cases, decreasing to 10.5% in the last 400 operated cases.

It is extremely important that the surgeon is aware of the potential for complications that a particular procedure can generate. The complications of shoulder arthroscopy are present in all published series and orbit the evolution of the experience of all surgeons. What fits to us, as educators, is to train surgeons with humility to closely follow their patients and the courage to identify and treat early complications that cross their path.

We considered as bias of the study the fact that different techniques of anesthesia and postoperative analgesia were used, as well as different modes of immobilization. We did not consider the rerupture of the sutured tendons of the rotator cuff as a complication, as this would imply current imaging tests in all patients.

Conclusion

The prevalence of complications of arthroscopic shoulder surgery for the treatment of sub acromial disorders was 15.8%.

It was not possible to demonstrate sex, obesity and smoking habit as risk factors for shoulder arthroscopy complications.

It was possible to demonstrate that the age under 65 years and the surgeon's learning curve significantly affect the prevalence of complications after shoulder arthroscopy.

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