Shoulder arthroplasty. Comorbidity as prognostic factor[☆]

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ABSTRACT

Introduction: Preoperative comorbidity seems to be an important factor for the functional recovery of patients after shoulder replacement, but few studies support this correlation.

The purpose of this study was to clinically evaluate the influence of comorbidity in restoring function after shoulder replacement.

Methods: We performed a retrospective analysis of shoulder replacement accomplished at our institution from 2005 to 2016 (n = 70). Demographic data, number of comorbidities, preoperative drugs, type of arthroplasty, and postoperative complications were collected. Functional results were evaluated according to the QuickDASH questionnaire.

Results: QuickDASH as continuous data was directly correlated with number of drugs prior to the surgical intervention ($R = 0.270$, $p = 0.024$) and number of comorbidities ($R = 0.280$, $p = 0.016$); especially neurological disorders ($R = 0.338$, $p = 0.004$) and osteoporosis ($R = 0.0242$, $p = 0.043$). The QuickDASH score is inversely correlated with patient satisfaction ($R = -0.621$, $p < 0.01$) and with gender (male) ($R = -0.469$, $p < 0.001$).

When the patients were divided into 2 equally sized groups according to the QuickDASH score, statistical significance was found between the group with the worst outcome and female sex (91.2%) ($p < 0.001$), neurological disorders ($p = 0.004$), alcohol consumption ($p = 0.028$) and when shoulder arthroplasty is due to proximal humeral fracture ($p = 0.002$).

Conclusion: Better functional results are obtained in patients with less comorbidities.

Worse functional results are obtained in patients taking more drugs, in women, alcohol consumers and those after proximal humeral fractures. Preoperative clinical status must be optimized and the patients' comorbidities should be carefully taken into accounting order to ascertain the correct shoulder arthroplasty.

1. Introduction

Shoulder arthroplasty (SA) is an appropriate treatment option for degenerative shoulder disease. Several studies have shown excellent clinical results, with functional improvement and good pain relief.^{1–3}

During the last few years there has been a rapid increase in SA, with admissions for SA in the United States having increased fivefold in the last decade.⁴

Results of SA depend on several factors, such as 1/type of implant, 2/surgical technique, and 3/postoperative physiotherapy. Preoperative comorbidity seems to be a key factor for functional recovery after SA, however, few studies have focused on this.

In general, an increase in preoperative comorbidity was directly

related to an increase in hospital mortality, postoperative complications, hospital stay and cost.^{5–7}

Our hypothesis was that preoperative comorbidities determined the final SA result.

Our objective was to identify these comorbidities and define their influence on the final SA result.

2. Materials and methods

2.1. Patients and study design

This is an observational retrospective cross-sectional study. Data correspond to patients undergoing shoulder replacement in our

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Table 1
Inclusion and exclusion criteria.

	No.
Inclusion criteria	
Patient over 18 years operated by SA	106
Exclusion criteria	
Patient not found	16
Patient who died at the time of the study	10
Refusal to participate	4
Cognitive impairment that makes the interview impossible	2
Removal of the prosthesis due to complications	1
Primary prosthesis not performed in our center	3
Total	n = 70

institution from 2005 to 2016, where we obtained 103 patients (106 shoulders).

After applying the exclusion criteria (Table 1) a sample of 70 patients was obtained (n = 70). All replacements were performed by an experienced shoulder surgeon of our institution. The surgical technique was standardized following the principles established by Neer.^{8,9} Patients were placed in beach chair position. A deltopectoral approach was performed in most cases. Data were collected from the medical records, analyzing demographic data, type and number of comorbidities (Table 2), type and number of drugs, surgical indication, type of prosthesis, and postoperative complications. We analyzed the relationship between these data and patient satisfaction and functional outcome.

The functional outcome was measured with the QuickDASH questionnaire (Disability of the Arm, Shoulder and Hand Scale), where, in a scoring range from 0 to 100 points, 100 is the worst functional result.

The patient overall satisfaction was categorized as “not satisfied”, “satisfied”, and “very satisfied”.

The radiological assessment was made with true anteroposterior and axial views. A radiolucent line greater than 2 mm at the cement-bone interface was considered to be loosening. Superior migration was determined by the acromio-humeral distance on the AP view, with a distance less than 7 mm indicating superior migration of the prosthesis. Scapular notching was assessed on AP views.^{10,11}

In patients undergoing shoulder replacement after proximal humeral fracture, we evaluated the position of the greater tuberosity. We defined tuberosity malposition according to Boileau.¹² Greater tuberosity is well positioned when located 5–10 mm below the upper limit of the prosthetic head. Tuberosity resorption was defined when it is not visible on AP and axial views, and tuberosity displacement was determined comparing its initial and final position.

Table 2
Preoperative comorbidity.

Preoperative comorbidities	No.
Cardiovascular	
Arterial hypertension	47 (67%)
Arrhythmia	5 (7%)
Coronary vascular pathology	4 (5,7%)
Endocrine disorders	
Diabetes mellitus	17 (24,3%)
Hypercholesterolemia	30 (43%)
Thyroid disorders	0
Lung pathology	14 (20%)
Neurological disorders	7 (10%)
Psychiatric pathology	14 (20%)
Osteoporosis (diagnosed before surgery)	9 (13%)
Gastrointestinal pathology	2 (3%)
Rheumatic pathology	6 (8,6%)
Obesity (body mass index > 30 kg/m2)	36 (52,2%)
Smoking	4 (5,7%)
Other comorbidities	15 (21,8%)
Usual alcohol consumption	9 (13%)

2.2. Statistical analysis

The Kolmogorov-Smirnov test was used to determine if the variables follow a normal distribution. The normal distribution variables were expressed as mean $\pm$ SEM, while those with abnormal distribution were expressed as median and range. The Spearman or Pearson correlation was used to study the relationship between DASH and the other variables. Patients were divided into two similarly sized groups as a function of the DASH median.

For the quantitative variables, significance was determined by the *t*-student test for independent samples or the non-parametric Mann-Whitney test U.

Intra-group differences (before and after treatment) were analyzed using the paired sample *t*-test, or the Wilcoxon test for related samples. Categorical variables were expressed as frequency (percentage) and the chi-square test or Fisher's F test were used to compare groups. Statistical package for Social Sciences (SPSS, v.23) was used for statistical calculations. A value of *p* < 0.05 was considered to be statistically significant.

The study was conducted according to the Good Clinical Practice and Guides of the International Conference of Harmonization, and, even though it is an anonymous study, each participant was asked for their verbal consent. All data were immediately anonymized by eliminating any relationship with the patient's identity, and thus avoiding any risk of loss of confidentiality. The study was approved by the Ethical Research Committee of Hospital Son Llàtzer, Palma de Mallorca.

3. Results

Seventy (66%) of the 106 shoulder arthroplasties were included in the final evaluation. Forty-nine patients were women (70%) and 21 men (30%). The mean follow-up period was 55 months (9–160).

The statistical analysis showed that the QuickDASH score was directly correlated with the male sex (*R* = −0.469; *p* < 0.001), indicating a better result in men. Likewise, when the patients were divided into 2 equally-sized groups as a function of the DASH median (36), a statistically significant association was observed between the group with the worst outcome (DASH > 36) and the female group (91.2%) (*p* < 0.001) (Table 3) (Fig. 1).

The mean age was 71 years (range 39–87 years). Even though no relationship between age and score (QuickDASH) was found, age, however, is related to the presence of complications (*p* < 0.01).

In 28 patients (40%) the intervened side was non-dominant, and in 42, the dominant side (60%). No relationship was found between the dominance of the affected side and the functional outcome according to the QuickDASH.

The reasons for the arthroplasty were: proximal humeral fracture (26 patients), cuff arthropathy (18 patients), irreparable rotator cuff tear (15 patients), osteoarthritis (6 patients), necrosis of the humeral head (4 patients), and arthritis of the glenohumeral joint (1 patient).

When the patients were divided into two groups according to the DASH median (36), a statistical association was observed between the

Table 3
Sex and functional results.

		QuickDASH		<i>P</i>	
		≤ 36	> 36		
Surgical indication	Fracture	8	22%	18	53%
	Rotator cuff arthropathy	11	31%	7	21%
	Massive cuff tear	8	22%	7	21%
	Degenerative arthritis	5	14%	1	3%
	Osteonecrosis	4	11%	0	0%
Sex	Arthristis	0	0%	1	3%
	Female	18	50%	31	91%
	Male	18	50%	3	9%

Fig. 1. Association between QuickDASH and sex.

group with the highest score and the group where the arthroplasty was due to a proximal humeral fracture ($p = 0.002$) (Table 1).

The following were the types of shoulder replacement: in 49 patients a reverse shoulder arthroplasty (70%), in 14 patients a hemiarthroplasty, and total shoulder arthroplasty in 7 patients. There were no differences in functional outcome depending on the type of implanted prosthesis.

Regarding the drugs that patients regularly took before the intervention, there were no significant differences in the functional outcome, with respect to the patient medication prior the intervention; be it antihypertensive medication, glycemic control medication, anticoagulant, anti-aggregants, pump inhibitors, protons, lipid-lowering agents, benzodiazepines and opioids. There was, however, a correlation between the score obtained in the quickDASH and NSAIDs or paracetamol ($R = 0.257$, $p = 0.031$). It was also found that there was a direct correlation between quickDASH as a continuous data and the number of drugs that the patient took prior the intervention ($R = 0.270$, $p = 0.024$) (Fig. 2).

Statistical correlation was found between the quickDASH score and the total number of comorbidities ($R = 0.280$, $p = 0.016$) (Fig. 3); osteoporosis ($R = 0.242$, $p = 0.043$); and neurological disorders ($R = 0.338$, $p = 0.004$).

A statistically significant association was also found with the group of higher comorbidities when the patients were divided into two groups according to the median ($p = 0.004$). Alcohol consumption was also associated with the worst functional outcome ($p = 0.028$). There were no differences in the functional outcome considering body mass index, obesity, smoking, hypertension, diabetes mellitus, arrhythmia, coronary disease, dyslipidemia, thyroid, pulmonary, gastrointestinal, rheumatic or psychiatric pathology. We found a high percentage of obese in our sample (52%). When we compare the percentage of obese individuals in the general Spanish population, in the age range of our patients (22%) with the obesity percentage of our sample, we found a significant difference ($p < 0.01$).

Nine (13%) patients were not satisfied with the results; 31 (44%) patients were satisfied and 30 (43%) were very satisfied. As expected, the score obtained in the DASH is inversely correlated with patient

satisfaction ($R = -0.621$, $p < 0.001$).

Prosthetic loosening was observed in 4 patients, and there was evidence of tuberosity failure in 8 cases, and scapular notch in 5 cases. The score on the quickDASH was not significantly different in patients with or without these radiographic findings. These data could have justification in a scarce sample.

Postoperative complications associated with surgery (nerve palsy, surgical wound infection, deep infection, dislocation, or glenoid fracture) were observed in 10 patients. The score on the quickDASH was not significantly different in patients with or without complications.

We analyzed the relationship between complications and comorbidities, and between complications and drugs consumption. No differences were found regarding the presence or absence of complications according to sex, total number of comorbidities and different comorbidities studied independently (obesity, number of drugs and different drugs individually evaluated). There was an association between the presence of complications and smoking ($p = 0.036$).

Revision surgery was necessary in 7 patients. Statistical correlation was observed between the quick DASH score and the need for revision surgery ($R = 0.292$; $p = 0.014$).

4. Discussion

Although several studies have assessed the relationship between preoperative comorbidities with mortality, postoperative complications, hospital stay and cost, few studies have focussed on the relationship between the different preoperative comorbidities and the recovery of function in patients treated by joint replacement of the shoulder. We evaluated the relationship of various comorbidities with the functional outcome and postoperative complications after SA.

Issa K et al. presented a higher rate of complications in female patients.⁴ Singh JA et al. found a relationship between sex (female) and an increased risk of thromboembolic event after SA.¹³ In another article, the same author identified the male sex as a risk factor for deep periprosthetic infection after SA.¹⁴ Hollatz MF et al. observed the relationship between the male sex and revision surgery after SA.¹⁵ In our study, we found no relationship between complications and sex.

Fig. 2. Correlation between quickDASH as a continuous data and the number of drugs.

Moreover, we found no study which relates functional outcome after SA with sex. We did, however, observe a direct relationship between males and a better functional outcome.

We found no association between age and functional outcome. While other authors found a relationship between age and a higher rate of complications,^{4,13} as well as age and a lower revision rates,^{9,15,16} we did not observe this.

A worse functional outcome was obtained when SA was implanted after proximal humeral fracture. This finding may be due to the worse condition of the soft tissues and the greater difficulty in implanting in these cases.

The number of drugs taken before the surgery was correlated with a worse functional outcome, and taking more drugs may be considered as an indicator of comorbidity. The association between acetaminophen

Fig. 3. Association between quickDASH and number of comorbidities.

intake and the worst functional outcome may be related to the presence of previous major degenerative disease or poor pain tolerance. Nevertheless, there is nothing in the literature about this relationship.

When focusing on the presence of comorbidities, there was a clear correlation between the quickDASH score and the total number of comorbidities. Osteoporosis, neurological alterations and alcohol consumption also present this correlation. There are no previous studies evaluating the relationship between comorbidity and functional outcome.

It is remarkable that 87% of the patients were satisfied or very satisfied with the results of the surgery.

Several papers show the association between comorbidities and complications. There is a statistical relationship between preoperative comorbidity, and an increase in postoperative complications, hospital mortality, hospital stay, and cost.⁶ Hypertension, diabetes, obesity^{13,18–20} and psychiatric pathology²¹ are factors independently associated with postoperative complications.¹⁸ Other studies showed no association between obesity and complications.^{6,17}

We found no differences when assessing the relationship between complications and comorbidities, and between complications and the consumption of the drugs. The quickDASH score was not significantly different in patients with or without complications. This may be due to the small sample.

The limitations of this study are the narrow sample size, and the retrospective nature of the study. We do not have a functional assessment prior to surgery. Therefore, individualized studies are needed to obtain more precise conclusions about the influence of each of the comorbidities on functional outcome. A detailed study could clarify the relationship between obesity and the risk of needing a shoulder arthroplasty.

5. Conclusions

Better functional results after shoulder arthroplasty are expected in patients with less comorbidities. We obtained worse functional results in patients taking more drugs, women, alcohol users, and when the indication was made due to a proximal humeral fracture. It is essential that we consider these data before deciding to perform a shoulder arthroplasty. It is possible to optimize the preoperative status of patients through smoking cessation and alcohol withdrawal.

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Ethical approval

Ethical approval from the Comité de Ética de la Investigación de las Islas Baleares. Study number IB 3586/17 PI.

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