J Shoulder Elbow Surg (2012) 21, 1039-1044

ELSEVIER

Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

SHOULDER

Risk factors for revision surgery after humeral head replacement: 1,431 shoulders over 3 decades

Jasvinder A. Singh, MBBS, MPH[a,b,c,*], John W. Sperling, MD, MBA[c], Robert H. Cofield, MD[c]

[a]*Medicine Service, Center for Surgical Medical Acute Care Research and Transitions, VA Medical Center, Birmingham, AL, USA*
[b]*Department of Medicine and Division of Epidemiology, University of Alabama at Birmingham, Birmingham, AL, USA*
[c]*Department of Orthopedic Surgery, Mayo Clinic College of Medicine, Rochester, MN, USA*

Hypothesis: To assess the long-term risk of revision surgery and its predictors after humeral head replacement (HHR).

Methods: We used prospectively collected data from the Mayo Clinic Total Joint Registry and other institutional electronic databases. Revision-free survival for HHR at 5, 10, and 20 years was calculated by use of Kaplan-Meier survival analysis. We used univariate and multivariate-adjusted Cox regression analyses to examine the association of age, gender, body mass index (BMI), comorbidity assessed by Deyo-Charlson index, American Society of Anesthesiologists class, implant fixation (cemented vs uncemented), and underlying diagnosis with the risk of revision surgery. Hazard ratios with 95% confidence intervals (CIs) and *P* values are presented.

Results: During the study period (1976-2008), 1,359 patients underwent 1,431 shoulder HHRs. The mean age was 63 years, 63% of patients were female, the mean BMI was 28 kg/m^2, and 60% of implants were cemented. During the follow-up, 114 HHRs were revised. At 5, 10, and 20 years, the shoulder implant survival rate was 93.6% (95% CI, 92.1%-95%), 90% (95% CI, 88%-92%), and 85% (95% CI, 81.8%-88.4%), respectively. In multivariate-adjusted analyses, older age was associated with a lower hazard of revision, with a hazard ratio of 0.97 (95% CI, 0.96-0.99; $P < .001$), and higher BMI was associated with a higher hazard ratio of 1.04 (95% CI, 1.01-1.08; $P = .02$).

Conclusions: Long-term survival of HHR at 20 years was excellent. Obesity and younger age are risk factors for a higher revision rate after HHR. Further studies should investigate the biologic rationale for these important associations. Surgeons can discuss these differences in revision risk with patients, especially young obese patients.

Level of evidence: Level IV, Case Series, Treatment Study.

Keywords: Shoulder hemiarthroplasty; humeral head replacement; revision; obesity; age

Humeral head replacement (HHR), also known as shoulder hemiarthroplasty, has been performed with good results for the treatment of patients with a variety of shoulder disorders.[4,8] In a recent systematic review, compared with total shoulder arthroplasty patients, HHR patients had statistically significantly worse functional scores; no significant differences in

This study was approved by the Mayo Clinic Institutional Review Board, and all investigations were conducted in conformity with ethical principles of research.

*Reprint requests: Jasvinder A. Singh, MBBS, MPH, University of Alabama at Birmingham, Faculty Office Tower 805B, 510 20th St S, Birmingham, AL 35294, USA.

E-mail address: Jasvinder.md@gmail.com (J.A. Singh).

1058-2746/$ - see front matter © 2012 Journal of Shoulder and Elbow Surgery Board of Trustees.
doi:10.1016/j.jse.2011.06.015

pain scores, quality of life, or adverse events; and a non-statistically significant trend toward a higher revision rate.[11] Two recent systematic reviews that included studies of both total shoulder arthroplasty and HHR have summarized revision rates from 23 studies[9] and 40 studies.[14] At a mean follow-up of 43 and 59 months, the combined revision rates were 10.2%[9] and 15%.[14]

Only 2 studies have estimated the revision rates after HHR. The revision rates were 6% to 8% at 5 years and 8% to 17% at 10 years.[5,13] Only 1 study has reported the 15-year revision rate, at 27%.[13] With low revision rates, a small sample size of 114 shoulders in 1 of the 2 previous studies limited the analyses.[13]

To our knowledge, only 2 studies have examined the predictors of revision surgery after HHR.[5,13] They included 74 revisions in 1,470 shoulders (6%)[5] and 11 revisions in 114 shoulders (11%).[13] An underlying diagnosis of trauma or fracture sequelae, previous surgery, and age lower than 70 years significantly increased the risk of revision, but gender was not significant.[5,13] Only 1 study used multivariate analyses.[5] Some findings were contradictory; for example, younger age was significantly associated with a higher revision rate in 1 study[5] but not the other.[13] None of the studies examined modifiable factors, such as comorbidity and body mass index (BMI). Given that higher BMI is associated with more unsatisfactory results in morbidly obese patients undergoing primary shoulder arthroplasty,[7] one needs to examine whether higher BMI is associated with a higher revision rate.

Our objective was to examine the revision rate in a large cohort of patients who had undergone HHR from 1976-2008 at our medical center. We examined (1) the revision rates at 5-, 10-, and 20-year follow-up and (2) whether higher comorbidity, BMI, age, gender, and type of implant were associated with risk of revision.

Methods

Study population

The Mayo Clinic Joint Registry was used to conduct this study. This prospective registry has captured every arthroplasty performed at the Mayo Clinic, Rochester, Minnesota, USA, since 1969, including all shoulder arthroplasties performed since 1976. The Mayo Clinic medical center provides primary and specialty care to residents of Olmsted County and specialty care to referred patients. All patients who undergo shoulder arthroplasty are invited to return for a clinic visit at 1, 2, and 5 years and then every 5 years for a standardized physician interview, clinical examination, and radiographs. Patients who are unable to come for a clinic visit are requested to complete a standardized shoulder questionnaire[12] and send radiographs. Those who do not return the questionnaire are contacted by telephone by trained registry staff and interviewed using a standardized shoulder questionnaire, including any additional surgery. In case a surgical procedure had been performed at an outside facility, data were requested including operative reports for indication, operative findings, and revision. The study cohort was defined as patients who underwent HHR between January 1976 and December 2008.

Outcome and predictors

The outcome of interest for this study was revision shoulder surgery for index HHR for any reason, as documented in the Mayo Clinic Total Joint Registry. Observations were censored for patients at death. We used the Total Joint Registry to obtain data on predictors of interest. Patient age at surgery, gender, underlying diagnosis, and implant fixation (cementing of humeral and/or glenoid component vs no cementing) are documented in the Total Joint Registry. Age was treated as a continuous variable. Underlying diagnosis was categorized as osteoarthritis, rheumatoid arthritis, rotator cuff disease, trauma, tumor, and other (avascular necrosis, ankylosing spondylitis, psoriatic arthritis, dislocation, and so on). We used other institutional electronic databases to obtain data on BMI, comorbidity, and American Society of Anesthesiologists (ASA) class at the time of HHR. BMI (in kilograms per square meter) was considered as a continuous variable. ASA class, a validated measure of perioperative death and morbidity,[3,15] was categorized as class 1 or 2 versus class 3 or 4 (where a higher class indicates worse physical status). Comorbidity was measured with the Deyo-Charlson comorbidity index,[2] a validated, commonly used, summative weighted scale of 17 comorbidities (including cardiac, pulmonary, renal, and hepatic disease; diabetes; cancer; and human immunodeficiency virus). All variables were available for the entire study duration, except BMI (available since 1987) and ASA class (available since 1988).

Statistical analyses

We present summary statistics for patient demographic and clinical characteristics as mean (standard deviation) or proportions. Revision-free survival at 5, 10, and 20 years was calculated by use of the Kaplan-Meier survival analysis method, censoring patients at death. We examined the association of each predictor of interest (age, gender, BMI, Deyo-Charlson index, ASA class, implant fixation, and underlying diagnosis) and revision using univariate Cox regression analyses. The main multivariate-adjusted Cox regression model (model 1) included all variables significant at $P < .05$ in univariate analyses and available for the entire study duration (all except BMI and ASA class). Model 2 included BMI in addition to model 1, and model 3 included ASA class in addition to model 1. BMI and ASA class were entered in separate models because they were available since 1987 and 1988, respectively. We present hazard ratios with 95% confidence intervals (CIs). $P < .05$ was considered statistically significant.

Results

Clinical characteristics

The patient characteristics are summarized in Table I. During the study period (1976-2008), 1,359 patients underwent 1,431 shoulder HHRs. The mean age was 63 years, 63% of patients were female, and the mean BMI was 28 kg/m^2; 60% of implants were cemented. The ASA class was 1 or 2 in 49% and 3 or 4 in