Serum Metal Ion Levels in Patients Undergoing Revision Shoulder Arthroplasty

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INTRODUCTION: Shoulder arthroplasty systems are transitioning towards more modular prosthesis options with the goal of reducing complication profiles and increasing range of motion. Modularity may increase the potential for fretting, corrosion, and subsequent release of metal ions. These events have been associated with adverse reactions in hip and knee arthroplasty, but not in the setting of revision shoulder arthroplasty. The purpose of this study was to identify associations between implant designs, metallurgy, patient characteristics, and serum metal ion levels in patients undergoing revision shoulder arthroplasty.

METHODS: 51 patients that underwent revision shoulder arthroplasty were retrospectively reviewed based on prospectively collected data. All patients had serum metal ion levels (titanium, cobalt, chromium) measured in parts per billion (ppb) prior to their revision arthroplasty. Trends and correlations to serum ion levels were examined based on implant materials, number of modular components, and patient characteristics. The Wilcoxon test was used to compare continuous variables between groups, while the Fisher's exact test was employed for categorical variables. RESULTS:

21 patients had prior anatomic total shoulder arthroplasty (ATSA) and 30 had prior reverse total shoulder arthroplasty (RTSA). The average age at primary arthroplasty was 64.7 years (49.0-84.0). The average term of implant was 4.67 years (0.24-20.99). 41 patients (89%) had titanium based humeral stems. In those with humeral heads, 18 (100 %) were comprised of cobalt chrome. 5 patients with prior ATSA had hybrid titanium and polyethylene glenoid components. In those with RTSA, 29 (100 %) had glenoid components composed of titanium baseplates and cobalt chrome glenospheres. The average number of modular components was 6.0 (2.0-9.0) including screws and 4.1 (2.0-6.0) excluding screws. Titanium ion levels were significantly higher in patients with greater than 7 total modular components (12.6 vs. 6.3 ppb, p=0.007). Titanium ion levels were significantly higher in patients with greater than 4 modular components when excluding screws (12.6 vs. 5.4, p = 0.039). The number of modular components did not have a statistically significant effect on cobalt or chromium serum ion levels. Patients with intraoperative metallosis during revision surgery had titanium ion levels 9.54 units higher on average (p = 0.028) than those without metallosis. There was no difference in titanium (p=0.60), cobalt (p=0.26), or chromium (p=0.32) levels in those patients with a proven infection compared to those without a proven infection.

DISCUSSION AND CONCLUSION: This is the first study to the authors' knowledge to examine preoperative serum metal ion levels in patients undergoing revision total shoulder arthroplasty. Increasing modularity in primary total shoulder arthroplasty should be weighed with the potential for increased serum metal ion levels. Metallosis poses challenges in the revision setting; however, the implications of increased serum metal ion levels on clinical outcomes after revision shoulder arthroplasty requires further studies.