

Blood metal levels and association with cardiac function and structure in total joint arthroplasty

Peter Charles Brennan¹, Thomas O'Byrne¹, Stephanie Mary Peterson, Mariana L. Laporta, Cody Wyles, Maria Vassilaki, Garvan Kane, Hilal Maradit-Kremers¹

¹Mayo Clinic

INTRODUCTION: There is growing concern regarding potential long-term cardiotoxicity with the use of metal implants in total hip (THA) and total knee (TKA) arthroplasty. The aim of this study was to correlate metal levels (cobalt, chromium, titanium) with cardiac function and structure in THA and TKA patients.

METHODS:

This cross-sectional study consisted of 115 patients with at least one prior THA or TKA. A convenience sample of patients were identified prospectively based on a previous record of elevated serum cobalt, chromium, or titanium levels following their joint replacement. Each patient had undergone transthoracic echocardiogram and a one-time blood draw on the same day to measure levels of cobalt, chromium, and titanium ions as well as cardiac labs including troponin and N-terminal pro b-type natriuretic peptide (NT-proBNP). Metal levels were correlated with echocardiogram measurements and cardiac labs with associations examined dichotomously (detectable vs undetectable) and continuously (levels "[<1 ng/mL](#)" was converted to 0.99 ng/mL).

RESULTS:

Detectable metal levels were found for cobalt (n=53, 47%), chromium (n=45, 40%) and titanium (n=92, 81%). Detectable levels of cobalt and titanium were associated with increased levels of NT-proBNP (p=0.04 and p=0.0007). On a continuous logarithmic scale, increased titanium was associated with decreased left ventricular cardiac output (r=-0.32, p=0.0007), decreased left ventricular stroke volume (r=-0.26, p=0.006), and increased levels of NT-proBNP (r=0.21, p=0.0326). Chromium was not associated with any echocardiographic measurements but was associated with decreased levels of troponin (r=-0.23, p=0.02) and NT-proBNP (p=0.0085).

DISCUSSION AND CONCLUSION:

Titanium was the most commonly elevated metal and we observed decreased left ventricular cardiac output, decreased left ventricular stroke volume, and increased levels of NT-proBNP in patients with elevated titanium levels. Further investigation of temporal relationships and quantitative thresholds for THA and TKA implant metals with cardiac pathology is warranted.