Association of Post-Revision Cobalt and Chromium Levels with Risk of Multiple Revisions after Primary Metal-on-Metal Total Hip Arthroplasty

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INTRODUCTION: Elevated blood metal ion levels can be a sign of failure of metal-on-metal (MoM) total hip arthroplasty (THA) and may remain elevated after revision THA, especially in patients with bilateral implants. While revision of the metal ion-generating implants generally reduces metal ion levels, it remains unclear whether persistent metal ion elevation after rTHA predicts the risk of subsequent contralateral revisions.

METHODS: We retrospectively reviewed 34 patients with MoM THAs who underwent revision for metallosis, comparing those who only had one side revised (“Single”, n=29) to those who underwent subsequent contralateral rTHA for metallosis (“Contralateral”, n=5). All patients in the contralateral group had bilateral MoM implants, while 19 patients in the single group had bilateral MoM implants, but only one side was revised for metallosis. Pre-and post-revision cobalt and chromium levels were analyzed. Complications unrelated to metallosis including infection, dislocation, and fracture were evaluated as well. Logistic regression was used to evaluate whether the proportion of metal ion reduction after revision was related to the chances of requiring the other side revised.

RESULTS: Cobalt and chromium levels decreased significantly after the first revision in all patients (P=0.001; P=0.035, respectively). Patients in the contralateral group retained more cobalt after index revision (2.2 [single] vs. 5.8 ppb [contralateral], P=0.001), but this was not true regarding chromium levels. Metal ion levels in patients who underwent bilateral revisions for metallosis further decreased after the second surgery. Logistic regression showed that the risk of contralateral revision was not significantly associated with the amount of metal retained or the presence of bilateral implants (n=19 within the single group). Complication rates unrelated to metallosis were comparable (13.8 vs. 20.0%, P=0.427).

DISCUSSION AND CONCLUSION: Our findings suggest that a higher retention of cobalt after index revision may increase the likelihood that a patient with bilateral metal implants will require a contralateral revision. This study highlights the importance of monitoring post-revision levels of both cobalt and chromium to help identify patients at risk for future MoM complications. Further research is needed to determine whether sustained elevation of metal ion levels following index rTHA should prompt consideration of earlier contralateral revision in patients with bilateral MoM THAs.

Table 3. Change in Metal Ions in Blood After Contralateral Revision for Metallosis

	(n=5)
Post-contralateral revision Cobalt, ppb [range]	2.8 [0.3 to 7.4]
% Cobalt post-index to contralateral, % decrease [range]	49.0 [-12.5 to 85.7]
% Cobalt pre-index to contralateral, % decrease [range]	77.8 [29.4 to 89.4]
Post-contralateral revision Chromium, ppb [range]	1.3 [0.6 to 7.7]
% Chromium post-index to contralateral, % decrease [range]	39.0 [9 to 51.0]
% Chromium pre-index to contralateral, % decrease [range]	57.1 [33.7 to 75.3]
Time to contralateral revision after index, mean [range] (years)	2.8 [0.3 to 4.2]

Table 1. Overall Changes in Cobalt and Chromium

	Pre revision	Post initial revision	*P* value
Cobalt (ppb), mean [range]	11.8	3.8	0.001
Chromium (ppb), mean [range]	7.9	3.8	0.035

Table 2. Change in Metal Ions in Blood After First Revision

	Unilateral Revision (n=19)	Contralateral Revision (n=5)	*P* value
Pre-revision Cobalt, ppb [range]	11.1 [2.1 to 67.0]	20.0 [6.1 to 87.2]	0.044
Post-index revision Cobalt, ppb [range]	2.2 [<0.6 to 8.0]	5.8 [2.0 to 11.0]	**0.001**
% Cobalt decrease [range]	77.1 [28.2 to 95.2]	42.8 [-28.2 to 86.8]	0.026
Pre-revision Chromium, ppb [range]	8.2 [1.0 to 41.1]	6.8 [1.7 to 7.8]	0.280
Post-index revision Chromium, ppb [range]	3.0 [<0.6 to 16.2]	1.9 [<0.6 to 7.4]	0.103
% Chromium decrease [range]	36.9 [0 to 95.8]	45.3 [-45.1 to 71.5]	0.521
Patients with bilateral MoM implants (n)	19 (95.5)	5 (100)	
Time to initial revision, years [range] (years)	11.9 [0.7 to 34.2]	10.0 [0.4 to 31.1]	0.287

Table 4. Complications and Reoperation

	Unilateral revision (n=20)	Bilateral revision (n=5)	P Value
Overall Complications, n (%)	4 (20.0)	1 (20.0)	0.427
Revision	1	1	
Dislocation	1	-	
Fracture	2	-	
Irrigation & Debridement	1	-	
Superficial Infection	1	-	
Open Reduction	-	1	
Periprosthetic Fracture	-	1	

Table 5. Logistic Regression Model for Contralateral Revision Risk

	Odds Ratio (95% CI)	*P* Value
Proportion of Co	0.992 (0.982 to 1.002)	0.116
Proportion of Cr	1.001 (0.993 to 1.012)	0.521
Bilateral Implants	1.714 (0.460 to 10.561)	0.311

Table 6. Patients with Increasing Ion Concentration After Index Revision

	Unilateral Revision (n=19)	Bilateral Revision (n=5)	*P* Value
Increased Cobalt Levels	2 (10.5)	0	0.395
Increased Chromium Levels	3 (15.8)	0	0.421