

Prosthetic Hip-Associated Cobalt Toxicity

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Abstract Prosthetic hip-associated cobalt toxicity (PHACT) is gaining recognition due to the use of metal-on-metal total hip replacements. Identifying true toxicity from merely elevated cobalt levels can be extremely difficult due to the lack of available data. An extensive review of the medical literature was undertaken to characterize cobalt toxicity from prosthetic hips. As an objective approach to making the diagnosis of PHACT, we suggest the following criteria: (1) elevated serum or whole blood cobalt levels due to a prosthetic hip, (2) at least two test-confirmed findings consistent with cobalt toxicity, and (3) exclusion of other etiologies. Adhering to objective diagnostic data for PHACT is a realistic and prudent method by which to eliminate the subjectivity of vague or difficult to identify complaints. These diagnostic criteria are not meant to evaluate prosthetic hardware failure, but as a means to identify systemic cobalt toxicity. Finally, assessment of cobalt toxicity from prosthetic hips should be done in conjunction with a medical toxicologist.

Keywords Cobalt toxicity · Prosthetic hips · Metal-on-metal hip

We would like to commend Dr. Devlin and colleagues for the insightful review of prosthetic hip-associated cobalt toxicity (PHACT). We too have performed an extensive review of the literature (albeit less formal) due to a number of cases referred to our medical toxicology clinic. Based on our experience, the evaluation of systemic cobalt toxicity is often complicated by

patient anxiety, comorbid conditions, or secondary financial gain. This influx of patients to our clinic is largely due to a lack of understanding in the interpretation of elevated cobalt levels by orthopedists and primary care physicians. Identifying true toxicity from merely elevated cobalt levels can be extremely difficult due to the lack of available data. We anticipate a continued increase in this patient population as this issue gains notoriety; thus, there is a need for a systematic approach to the evaluation and treatment of elevated cobalt levels from hip prosthetics.

As an objective approach to making the diagnosis of PHACT, we use the following criteria: (1) elevated serum or whole blood cobalt levels due to a prosthetic hip, (2) at least two test-confirmed findings consistent with cobalt toxicity, and (3) exclusion of other etiologies. Adhering to objective diagnostic data for PHACT is a realistic and prudent method by which to eliminate the subjectivity of vague or difficult to identify complaints. These diagnostic criteria are not meant to evaluate prosthetic hardware failure, but as a means to identify systemic cobalt toxicity.

Serum and whole blood cobalt levels were initially used to monitor metal-on-metal hip prosthetic mechanical failure. Medicines and Healthcare Products Regulatory Agency suggests blood cobalt levels greater than 7 µg/L as an actionable level for the evaluation of mechanical failure. We believe that this recommendation has been over-generalized as a sign of systemic cobalt toxicity. Using our criteria on the published cases of systemic cobalt toxicity from a prosthetic hip, serum cobalt levels are much higher before systemic toxicity is objectively identified. Admittedly, these elevated levels have poor positive and negative predictive values and must be interpreted by a medical toxicologist within the context of the individual's clinical scenario. However, PHACT has only been diagnosed in conjunction with objective testing when the serum cobalt levels approach 100 µg/L.

Patients with prosthetic hips tend to be older with comorbidities and are likely to develop cognitive decline, cardiomyopathy, decreased hearing, decreased visual acuity,

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peripheral nerve paresthesias, and/or hypothyroidism. We believe that a formal and systematic approach should be completed with at least two test-confirmed clinical findings consistent with toxicity prior to establishing a diagnosis of PHACT. The most consistent, clinically compelling, and objectively demonstrable abnormalities reported in the literature from systemic cobalt toxicity include sensorineural hearing impairment, vision loss, cognitive impairment, cardiac failure, neuropathy, and hypothyroidism. Therefore, we suggest that the following tests be performed to aid in diagnosis: comprehensive neuro-cognitive testing, echocardiography, audiometry, nerve conduction testing, electromyography, and formal ophthalmologic evaluation. Though hypothyroidism has been clearly associated with systemic cobalt toxicity, abnormal thyroid function testing is too nonspecific and commonplace to be utilized in the diagnostic criteria. Moreover, joint pain or swelling, change in ambulation, or noise from the hip are not included as these are signs of mechanical failure rather than systemic cobalt toxicity.

As discussed in the review from Devlin et al., cobalt exposure from prosthetic hips requires a thoughtful evaluation from medical toxicologists. As medical toxicologists, we are trained to evaluate elevated metal levels in conjunction with a patient's symptoms and make ultimate judgment about sys-

temic toxicity. Due to the paucity of research, this evaluation may be cumbersome. Therefore, we recommend clinical decision making based on objective testing. Although a lack of evidence-based diagnostic recommendations exist, these tests should be used to exclude other etiologies, or, alternatively, used in concert with clinical presentation, elevated levels and timing of prosthetic placement and development of symptoms to establish the diagnosis. Adequate information is available to provide guidance for a medical toxicology evaluation, and although no gold standard criteria exist, enough clinical information is available to strongly suggest the diagnosis. Because the diagnosis requires an amalgamation of information that must be interpreted, a case-by-case approach in conjunction with an orthopedic surgeon must be implemented to determine whether prosthetic hip removal is indicated. We likewise suggest real-time surveillance and active discussion among toxicologists caring for such patients to quickly identify trends, tailor diagnostic approaches, and add to the deficiencies in the literature with the hopes of making an evidence-based decision tool to guide management of elevated cobalt levels in the setting of prosthetics hips.

Conflict of Interest None