

Metal Hypersensitivity in Anterior Cervical Discectomy and Fusion: A Case Report

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Abstract

Orthopedic implant induced metal allergic response is not only a rare occurrence but very difficult to predict in surgical patients. Spinal implants, composed of metal alloys with an oxidative coating, are certified to ASTM standards and are safe for use in most cases however; this case study presents a 44-year-old female who displayed a full body maculopapular skin rash to a cervical implant used in her anterior cervical discectomy and fusion (ACDF) surgery. After immune response was confirmed by diagnostic tests, the plate was removed from the patient and her symptoms subsided. Alternatives to orthopedic implant surgeries must be considered for patients with metal hypersensitivity.

Keywords: Metal Hypersensitivity; Anterior Cervical Discectomy and Fusion (ACDF)

Introduction

Spinal implant related metal hypersensitivity is a rare complication that can manifest itself into systemic responses such as eczema, urticaria and pruritus as well as severe reactions such as chronic pain, osteolysis or implant loosening [1]. Implant devices are composed of metal alloys with an oxidative coating that inhibits corrosion when introduced into a biological environment. It is hypothesized during device normal wear; ions from the protective coating are slowly released into the body, exposing the alloy surface. Blood chemicals accelerate the corrosive process resulting in ion release into the patient's body [1]. In general it is believed in metal allergy cases, a combination of metal ions/corrosive debris plus native bodily proteins can cause a hypersensitivity reaction while eliciting an immune response [2,3].

Spinal device alloys are a combination of metals with the major components being titanium, nickel, cobalt or chromium which all are confirmed to cause allergic reactions [4,5]. It is also known that titanium particulate debris can cause a cytokine-mediated response which induces an inflammatory cascade and osteolysis [6].

Patient metal hypersensitivity screening, a skin patch test, can be a valuable tool for pre-operative testing for any orthopaedic implant surgery cases in patients with metal/skin reactions [7].

Purpose of the Study

The purpose of this paper is to report a rare case of metal hypersensitivity after anterior cervical discectomy and fusion (ACDF) in an adult.

Case Presentation

This individual is a 44-year-old female who underwent an ACDF with an Atlantis Vision® Elite plate manufactured by Medtronic, Minneapolis, MN on October 12, 2015. There were no complications during her surgery. On December 9, 2015 the patient developed an itchy macular rash on her left side chest wall and was diagnosed with a rash of unknown etiology (Figure 1a). For the next 24 - 48 hours, the patient's rash spread and worsens causing her extreme pruritus, swollen macular patches, tender, raw, inflamed, and thickened skin (Figure 1b and 1c). Her rash was therapy resistant. On December 15, 2015, punch biopsies of the patient's rash on left superior gluteus maximus and left mid-flank were taken.



Figure 1a: First presentation of itchy macular rash of left chest wall.



Figure 1b: Post 24 of initial presentation: rash worsening.



Figure 1c: Post 48 hours: extreme pruritus, swollen macular patches, tender, raw, inflamed and thickened skin.

A pathological analysis of the biopsy specimens identified spongiotic dermatitis, with differential diagnoses including nummular dermatitis, atopic dermatitis, and eczema. The microscopic description revealed a superficial perivascular infiltrate of lymphocytes and histiocytes along with eosinophils. The epidermis demonstrates spongiosis with overlying compact hyperkeratosis and focal parakeratosis. The Metal-LTT analysis Report revealed mild Lymphocyte Stimulation Index (LSI) of 2.4 for titanium alloy particles. Biopsy results suggested the patient had an allergic reaction.

The Metal-LTT analysis measures the proliferation of lymphocytes following exposure to a series of different metals. The level of reactivity to each metal is reported as a Stimulation Index (SI), and an SI over 2 is considered a positive reaction. Based on the patient's biopsy results supporting a diagnosis of allergic dermatitis, in addition to the Metal-LTT analysis reporting a mild immune response to titanium alloy, it was concluded that the patient had an allergic reaction to the Atlantis Vision® Elite cervical plate.

Radiology exams at six weeks post-ACDF confirmed that the patient had a solid fusion at C5-C6, and she decided to undergo plate removal on December 18, 2015.

During the revision procedure there was no evidence of seroma or inflammation around the plate. Within 5 days of plate removal, her rash symptoms started to subside (Figure 1d). Initially, the rash on the patient's face resolved followed by her chest and legs. It was not until the end of January 2016 that she had fully recovered (Figure 2).



Figure 1d: 3 - 5 days post implant removal: symptoms subsiding.



Figure 2: Full recovery January 2016.

Discussion and Conclusion

The frequency of skin metal hypersensitivity among the general public ranges from 10% to 15%. Skin hypersensitivity does not perfectly correlate with implant hypersensitivity, making an implant-related metal allergy reaction difficult to predict. Patients with superficial skin reactions to metals might not be candidates for metal-based implant surgery but this is unexplored.

This patient presented herself at our clinic on October 12, 2015 but did not disclose any history of allergies. It was only after her surgery did she disclose that she had an allergic reaction to red pigment used on her arm in a tattoo in 2013 (Figure 3a). Red pigment has been documented to contain allergic inducing metallic elements such as aluminum, iron, and titanium [8]. The patient's red pigment reaction presented itself as an itchy eczematous eruption, treatable only with surgical resection of the pigment infused epidermis/dermis (Figure 3b).



Figure 3a: Red pigment allergy in tattoo.



Figure 3b: Surgical resection of red pigment infused epidermis/dermis.

Approximately nine weeks after her ACDF procedure the patient developed a pruritic rash and was subsequently diagnosed with allergic dermatitis on her trunk, left mid flank, bilateral upper extremities, bilateral lower extremities, and left superior lateral gluteus maximus. The rash, described as scaling, lichenoid patches with discrete areas of erythema, vesiculation, and weeping, was resistant to treatment with oral prednisone, oral and intramuscular triamcinolone, and intramuscular hydroxyzine. A dermatopathological analysis of specimens collected on December 15, 2015 supported the clinical diagnosis of allergic dermatitis, and the results of a Metal-LTT report confirmed the patient was mildly reactive to titanium alloy particles.

Considering the clinical evaluation and laboratory analyses completed in December 2015, in addition to the patient's documented history of allergic response to red tattoo pigment in 2013, it is hypothesized that the patient experienced a cell-mediated delayed-type (type IV) hypersensitivity reaction to the titanium alloy in the Atlantis Vision® Elite plate implanted on October 12, 2015. Although the pathogenesis is not fully understood, the link between metal implants and delayed-type hypersensitivity reactions is well documented in the

literature [9, 10]. Furthermore, the patient's diagnosis is consistent with diagnostic criteria for dermatitis secondary to metallic implant identified by 119 dermatologists surveyed at the 2012 European Society of Contact Dermatitis and 2013 American Contact Dermatitis Society meetings, including therapy resistant dermatitis, histology consistent with allergic dermatitis, a positive *in vitro* test to metals (Metal-LTT), and complete recovery after implant removal [11].

The Atlantis Vision® Elite plate, certified to ASTM standards, is composed mainly of titanium alloy with small percentages of iron, aluminum, and vanadium. With over 20 years of experience in spine orthopaedics and no documented complications associated with the use of Atlantis Vision® implants, the corresponding author selected the Atlantis Vision® Elite implant for use in the clinic specifically because it is free of nickel, a common cause of metal hypersensitivity [11]. ASTM certified implants could be a risk for metal hypersensitivity patients therefore; an ACDF without plate would have been preferred if the tattoo skin reaction would have been known. In general, patients with a history of metal hypersensitivity can undergo an ACDF procedure without the use of metal plate, followed by placement in a cervical collar for six weeks.

Consent

The patient, receiving the explanation that her photos and data are published, agreed to its content.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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