

Resolution of Metallic Biliary Stent Allergic Reaction After Partial Stent Removal in a Patient with Nickel Sensitivity

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Received: 6 October 2016 / Accepted: 31 January 2017

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Abstract Local and systemic reactions to implanted metallic devices, particularly to those containing nickel, are well documented. Metal ions are released due to exposure of the metal to blood, proteins, other body fluids, and sheer mechanical stress. Metal ions then complex with native proteins and become antigens, which can elicit hypersensitivity reactions. Another case report depicts a specific allergic complication (early stent occlusion) related to metallic biliary stent implantation. We present a case of allergic symptoms, associated with eating, in a patient who developed nickel sensitivity after biliary metal stent placement confirmed by allergic skin testing to the same metallic biliary stent placed one year earlier. Symptoms resolved following partial removal of the non-epithelialized portion of the biliary stent.

Keywords Biliary stent · Allergy · Nickel · Allergic reaction · Metallic · Hypersensitivity

Introduction

Local and systemic reactions to implanted nickel-containing metallic devices are well documented. Metal ions are released due to exposure of the metal to blood, proteins,

other body fluids, and sheer mechanical stress. The ions then complex with native proteins and become antigens, which can elicit hypersensitivity reactions. We present a case of allergic symptoms, associated with eating, in a patient who developed nickel sensitivity after biliary metal stent placement confirmed by allergic skin testing to the same metallic biliary stent placed one year earlier.

Case Report

The patient is a 62-year-old woman who presented with a history of chronic right upper-quadrant abdominal pain, progressing in severity for several years. Her complex abdominal surgical history included: an initial Roux-en-Y gastrojejunostomy, antrectomy, and vagotomy 30 years prior for severe bile reflux gastritis; an exploratory laparotomy and adhesion lysis with resection of the distal stomach, revision of the Roux-en-Y anastomosis, and distal jejunojejunostomy 2 years prior; and ongoing abdominal pain and concern for afferent loop syndrome, for which a third exploratory laparotomy with additional adhesion lysis and resection of two segments of strictured bowel near previous anastomoses was performed 18 months prior to presentation.

She was referred to a gastroenterologist with symptoms of ongoing pain and chronic anemia, for which endoscopy of the anastomoses demonstrated no marginal ulcers. Ongoing pain was believed to potentially be due to sphincter of Oddi dysfunction. An MRCP demonstrated minimal extrahepatic ductal dilatation, with an 8-mm distal common bile duct (CBD), suggestive of a post-inflammatory ampullary stricture. Therefore, she underwent elective percutaneous transhepatic cholangiogram, which demonstrated a focal high-grade short ampullary stenosis,

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dilatation of the distal common bile duct stricture with a 10-mm high-pressure balloon (Conquest, Bard, Tempe, AZ), and placement of an 8-French (Fr) internal–external-type biliary drainage catheter (Boston Scientific, Natick, MA). All brushings and ductal tissue biopsies were negative for malignancy. A plan for serial dilatation over the next 3–4 months followed by drain removal was developed, but the patient elected to transfer care to a hospital in a neighboring state, to receive continued care closer to home.

The patient re-presented to the authors' medical center one year later. At the outside hospital facility, she underwent conversion of the percutaneous biliary drainage catheter to an internal metallic stent (Luminexx, Bard, Tempe, AZ) and removal of the biliary drain (1 month after initial drain placement). Following stent placement, she reported that she developed a progressive history of nausea, constant itching, and development of hives all over her body shortly after eating, which resolved after 30–60 min. She also developed worsening and progressive asthma attacks (unrelated to food intake), escalating to 3–4 times per week and requiring chronic corticosteroid use for relief. She did not tolerate antihistamine medications, as she developed psychiatric side effects. She also reported progressive weight loss, now at a total body weight of 90 lbs. She had normal liver function tests and bilirubin (0.4 mg/dL), with a mildly elevated alkaline phosphatase level (159 IU/L, normal <105 IU/L).

She underwent evaluation by an allergy immunologist, who performed a series of skin allergy tests for potential allergens. Using the same brand of biliary stent placed as the test allergen, she developed a vigorous local positive dermatologic allergic response, consistent with a nickel allergy. Based on this finding, she was diagnosed with an allergy to the nickel-based metallic biliary stent.

At that point, she was referred back to the authors' medical center, one year after metal stent placement, for consideration of options for stent retrieval. The hepatobiliary and pancreatic surgical team reviewed her case and deemed that surgical resection was not an option given her extensive prior surgical history. Given her altered anatomy, the advanced-endoscopy gastroenterologists believed that removal of the stent via an endoscopic retrograde cholangiopancreatography (ERCP) procedure with retrograde access to the ampulla was not possible. Both services requested interventional radiology-attempted stent retrieval.

Procedure Details (Fig. 1)

A detailed discussion of the procedure, including consent for all potential steps performed, was held with the patient and her family. The procedure was performed under general anesthesia.

Initially, a percutaneous transhepatic cholangiogram was performed under fluoroscopy using a 21 g percutaneous access needle (Cook, Bloomington, IN). The cholangiogram demonstrated a non-dilated intrahepatic biliary tree with brisk flow of contrast through the metallic stent into the duodenum. The proximal end of the stent closely approximated the duct wall, while the distal end of the stent extended freely into the duodenal lumen. As the likelihood of successfully snaring the proximal end of the stent was considered low, upstream access to the stent with percutaneous transhepatic catheter access to the biliary tree was not obtained.

Next, the duodenal bulb was accessed for antegrade access of the ampulla and distal stent. Of note, the patient was status post total gastrectomy, including removal of the pylorus. To do this, a second 21 g needle was used to percutaneously access the duodenum (opacified with contrast) and air was injected to distend the first part of the duodenum. A cone-beam CT was performed to localize the duodenum and identify a narrow window for percutaneous access, and enteral access was obtained and secured with T-tacks (Kimberly-Clark, Bloomington, IN). A 10Fr sheath was placed into the duodenum, and the distal stent was snared using a 30-mm gooseneck snare using a tri-axial platform (6Fr Simmons-2 guiding catheter inside a 6Fr torque-able Morph sheath, both through the 10Fr sheath). The distal stent was successfully captured, and attempts to advance the sheath over the stent (to separate the stent from the CBD wall) were partly successful. However, the proximal portion of the stent remained fixed within the CBD, and the stent fractured at the distal third junction. The fractured portion of the stent was removed with a snare-and-forceps biopsy device, and additional pieces protruding into the duodenum were also removed. The remainder of the stent remained within the common bile duct and was inaccessible. The access sheath into the duodenum was exchanged for a 14Fr MIC G-tube, and the patient was transferred to the post-anesthesia care unit in stable condition.

Post-procedure Clinical Course

Following the procedure, the patient developed abdominal pain, severe pancreatitis, and pancreatic ascites, which required intensive care unit admission and supportive medical management. She remained intubated for 3 days after the procedure. Her post-procedure pancreatitis resolved over 7–10 days, and she was discharged to a step-down facility in good condition, followed by discharge home several weeks later. Her enteral tube was removed 6 weeks after placement (Fig. 2).

Fig. 1 Stent retrieval procedure. The patient returns 1 year later after having a metal stent placed at an outside hospital. **A** Fluoroscopic spot image from percutaneous transhepatic cholangiogram via a needle demonstrates contrast flow through the CBD metal stent, into the duodenum. **B** Percutaneous needle and microwire enteral access were obtained into the duodenal bulb. **C** Following placement of two T-Tacks to secure the duodenal bulb wall to the anterior abdominal wall, a tri-axial system was placed via the enteral access site using a 10Fr Check-Flo sheath, a 6Fr Morph sheath, a 6Fr Simmons-2 guiding catheter, and a gooseneck snare. **D–E** This was used to capture the exposed distal end of the stent within the duodenum and the distal third of the metal stent was pulled into the 10Fr sheath and removed. **F** A fluoroscopic image demonstrates the remaining portion of the embedded stent within the main CBD. No portion of the stent extended into the duodenum

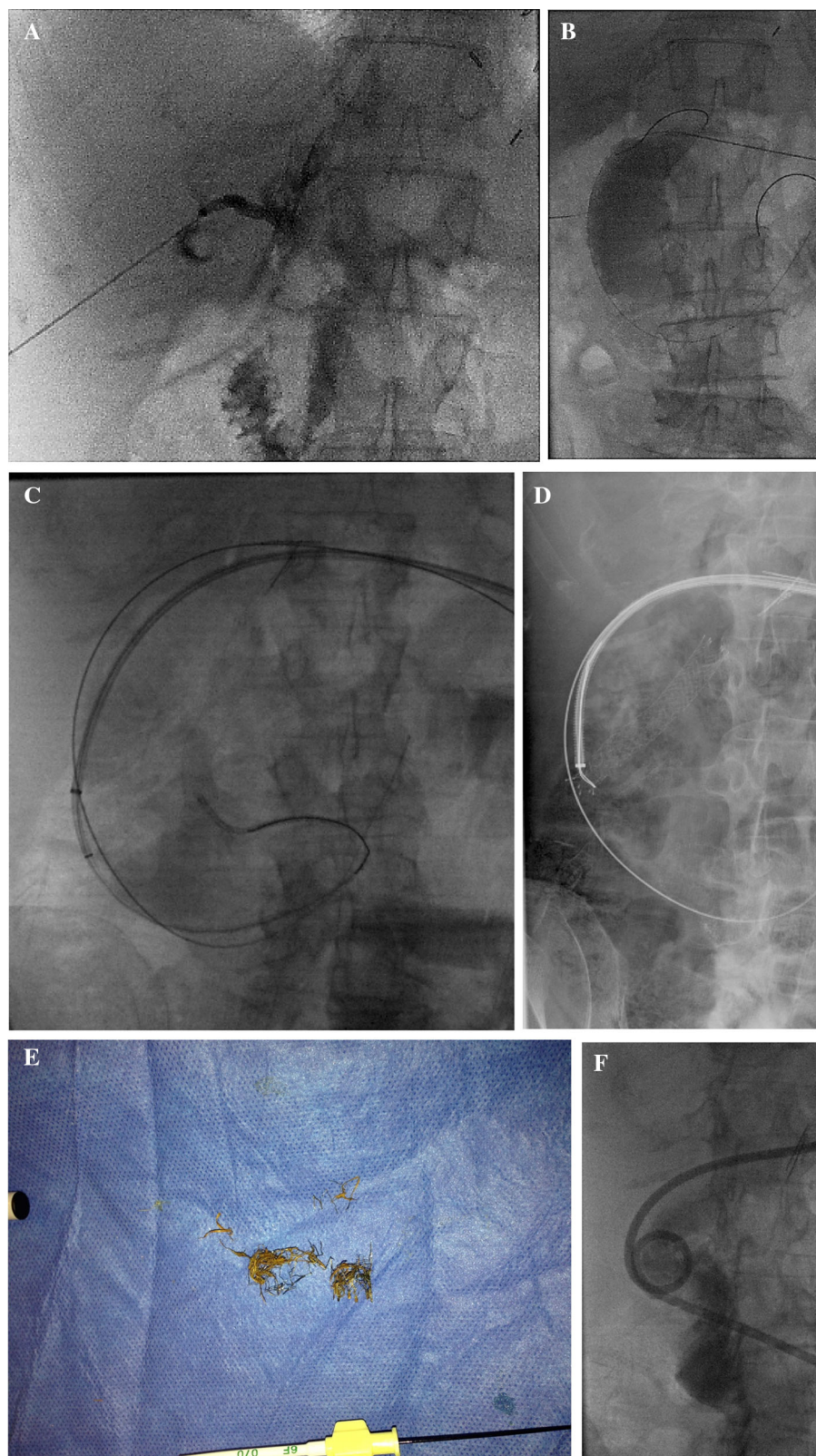




Fig. 2 Follow-up CT scan with iodinated intravenous contrast demonstrates the remaining unremoved metal stent within the CBD. **A** One month post-stent retrieval axial contrast-enhanced CT scan demonstrates the gastrostomy tube in the duodenal bulb, and **B** the remaining portion of the stent within the distal CBD on a coronal image. The patient's allergic symptoms had resolved after partial removal of the non-epithelialized portion of the metal stent

Resolution of Symptoms of Nickel Allergy

The patient's symptoms attributed to the nickel allergy, including nausea, hives with eating, and recurring asthma attacks, completely resolved after the stent retrieval procedure.

Discussion

Local and systemic reactions to implanted metallic devices, specifically those containing nickel, are well documented [1–4]. In these patients, metal ions are released due to

exposure of the metal to blood, proteins, bile, and sheer mechanical stress [1, 2]. In some individuals, metal ions complex with native proteins and act as antigens, which can in turn elicit hypersensitivity reactions. Among metals known to act as haptens, nickel is the most common sensitizer, comprising 10–20% of cases [1–3].

Nickel allergy often manifests as primary dermatitis with eczematous or papular eruptions in areas of direct contact, or as secondary dermatitis with extensive, symmetrical lesions [3]. Nickel can induce symptoms after oral ingestion, inhalation, or implantation of internal metallic devices. Bronchial asthma, fever, pericarditis, and dependent edema have been reported [4]. A type IV delayed-type hypersensitivity reaction, caused by specific metal-induced lymphocyte activation, is the mechanism of action with implanted devices. Immediate humoral responses (type—I, II, and III) reactions to nickel are also possible [1].

Allergic reactions to metal implants have been associated with postoperative complications and implant failure, sometimes necessitating device removal for symptom relief. In addition to orthopedic implants, metallic coronary stents and atrial septal occluder devices are most implicated in metal allergy-related complications. Two studies proposed that allergy to the components of coronary stents resulted in allergic inflammation, producing neointimal proliferation and in-stent restenosis [5, 6]. Allergic inflammation is caused by metal allergen-binding of IgE antibodies, degranulation of mast cells, histamine and cytokine release, and resulting inflammatory cell influx.

A similar case report of an allergic complication related to metallic biliary stent implantation has been published [7]. In their case, a 58-year-old female patient with known nickel allergy experienced episodes of right upper-quadrant pain, fevers, jaundice, anorexia, and lassitude, potentially associated with low-grade infection. Her symptoms resolved after removal of the entire biliary stent, which was found to be completely occluded and positive for multiple bacterial species on culture. The authors suggested that an inflammatory allergic response led to a rapid, disproportionate growth of biliary epithelium into the stent wall, causing early occlusion of the stent.

Our case describes an example of metallic allergy-related symptoms (e.g., urticaria, nausea, recurrent bronchoconstriction), specifically associated with ingestion of food, in a patient with a confirmed allergy to the specific implanted biliary stent. It has been documented that metals in prolonged contact with body fluids or subjected to mechanical stress elute component ions that can induce an allergic reaction [1, 2]. Dermatologists theorize that direct skin contact with nickel produces nickel salts that can diffuse into the skin or penetrate into the circulatory system and cause systemic allergic reactions [3]. After food ingestion, bolus, secretin-, cholecystokinin-, and

acetylcholine-induced gallbladder contraction results in the release of bile [8].

We hypothesize nickel metal in the non-epithelialized portion of the biliary stent was exposed to these bile fluids, which resulted in device corrosion and release of metal ions. Although the majority of observations agree that most nickel implants show little visible signs of corrosion after retrieval, the absence of visual changes does not mean that no surface degradation occurs [9]. Another study reports that the high acidic content and chlorine ion content in gastric and digestive juices are the most corrosive medium for nitinol, with a 2–3 times increase risk of breakdown potentials observed in the blood [10]. The released nickel metal ions then complex with native proteins and act as antigens to elicit a hypersensitivity reaction with the specific symptoms described in our case, including those timed to food ingestion.

Removal of only the non-epithelialized exposed portions of the biliary stent resulted in marked improvement of the patient's symptoms. Mucosal hypertrophy, epithelial hyperplasia, and resulting biliary tissue ingrowth are known to occur with implanted biliary stents. Additional techniques, such as laser-sheath technology, now commonly used to remove other embedded implanted devices such as inferior vena cava filters [11], may have been useful in removing the entire stent in this case. However, this technology was not available at the authors' institution at the time. Regardless, as her allergic symptoms resolved immediately with removal of the exposed, non-epithelialized portion of the stent only, we believe that the nickel metal in the epithelialized portion of the stent was "shielded" from the corrosive effect of the bile fluids, limiting release of metal ions from this portion of the stent. The episodic, rather than persistent, nature of her systemic allergic symptoms is in line with the other cited case in the literature [7].

Some clinicians have advocated for skin patch and a detailed clinical history of prior reactions before implantation of metal devices. Due to the rarity of this condition, and increasing use of implantable devices in healthcare, routine patch testing in all patients prior to metallic biliary stent placement is likely not cost-effective nor efficient. Rather, our case reports that the development of an allergy to nickel could be a rare cause of hypersensitivity from metallic stents placed in the distal biliary tree, and this may be confirmed with skin testing. It would be of benefit for the interventional radiology operator and the patient's

clinical team to be aware of the possibility of such an allergic reaction and to consider potential stent removal, if the symptoms are unremitting.

Compliance with Ethical Standards

Conflict of interest All authors have no grant information or grant support to disclose.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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