Contraceptive Implant Migration and Removal by Interventional Radiology

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Abstract

As the reversible contraceptive arm implants grow more popular, there is an increasing need to recognize the complications resulting from implant migration and removal. This review summarizes the findings of imaging and removal methods. When an implant is lost, the axillary region should be investigated first. If the implant still cannot be found, visualization through different methods have been employed for non-radioopaque implants. Real-time fluoroscopic-guided localization and removal can be accomplished for radiopaque Nexplanon. Once the implant has been located, standard removal method and other modified techniques can be used to safely remove the implant depending on the implant's location.

Keywords

- interventional radiology
- contraception
- implant
- women's health

Objectives: Upon completion of this article, the reader will be able to identify the role of interventional radiology in the implantation and removal of contraceptive devices placed in the arm, as well as the techniques associated with such procedures.

Contraceptive arm implants are reversible contraceptive methods that deliver long-acting systemic dose progestin via a subdermal implant. Since the 1990s, the use of these contraceptives has slowly increased across the world; in 2010, it was estimated that 3 million implants were fitted worldwide.¹ In the United States, the use of these devices has tripled from 2006 to 2013.² The implants are more than 99% effective at preventing pregnancy, and can be used in patients with complex medical conditions. The high efficacy and tolerability has led to both adult and pediatric guidelines recommending implants as a preferred, first-line contraceptive option.^{3–5}

Contraceptive implants were first introduced in the form of Norplant in 1983. Norplant is a six-rod 216-mg levonor-

gestrel implant that is inserted subdermally approximately 8 to 10 cm above the elbow on the inner aspect of the nondominant arm under general anesthesia, and ultimately removed through a 4-mm incision in the original site. To reduce the higher risk of complications with removal (2.44–9.76%),⁶ a two-rod 150-mg levonorgestrel implant was manufactured in 1998.⁷ Currently, levonorgestrel-releasing systems are not available in the United States. However, Jadelle or Sino-implant (two-rod implants) and Norplant (six-rod implant) are still being used in a variety of other countries.

In the United States, a single-rod 68-mg etonogestrel subdermal implant (Implanon) was approved in 2006; however, it has been used around the world since 1998. The device is the size of a matchstick, and is inserted at the inner side of the nondominant upper arm approximately 8 to 10 cm (3–4 inches) above the medial epicondyle of the humerus; it is performed as a simple outpatient office procedure (by both primary care providers and reproductive health specialists). Due to concerns of deep dermal/intramuscular insertions as well as migration away

from the insertion site, the implants were discontinued and replaced with Nexplanon in 2011.⁸ Nexplanon is currently the only contraceptive arm implant available in the United States; it has the same size and progestin content as Implanon, but has 15 mg of barium sulfate to allow visualization if it is no longer palpable at the insertion site. In addition to allowing for visualization by X-ray imaging, the Nexplanon inserter was also redesigned for easier use, to minimize the chance of deep insertion or inadvertent noninsertion. Nexplanon insertion is a brief office procedure that can be performed in 2 to 3 minutes by trained providers.⁹ Removal of the implant is also an office procedure requiring local anesthesia, sterile mosquito forceps, and a no. 11 scalpel. Removal of a palpable implant is typically done without imaging and occurs in an average of 3.6 minutes.⁹ However, with nonpalpable etonogestrel implants, localization methods must be used to confirm the presence of the implant before attempts at removal. In Levine's studies of 330 females with Implanon implants, approximately 2% of females experienced removal complications requiring greater than 20 minutes for implant removal.⁹ In 2017, the 6-year experience of real-world Implanon/Nexplanon insertion and removal procedures was published, as part of the postmarketing commitment of the manufacturer with the U.S. Food and Drug Administration. Information voluntarily provided by practitioners suggested low (<1%) incidence of insertion complications, including difficult or deep insertions, the presence of no implant after insertion procedure, multiple rods inserted at the same time, or insertion at the wrong site.¹⁰ Reported concerns with removal were somewhat higher, with 5.93% of the respondents reporting a removal problem, as well as migration from the site (0.26%), requiring surgical removal under anesthesia (0.05%), and lost implants (0.02%). These may represent underestimates given that this was a voluntary program with low response rates, as well as a lack of clinical confirmation of complications.

Over the past 35 years, contraceptive implants have expanded to more than 60 countries and millions of women. As the implants grow more popular, there is an increasing need to be cognizant of complications resulting from both implant migration and implant removal. Several case studies of implant migration (defined as movement 2 cm or more beyond the insertion site) and image-guided removal methods have been published throughout the years.

When migration occurs, it may damage major nerves due to the proximity of the neurovascular structures with the contraceptive implants.¹¹ Without visualization of the implants through imaging techniques, removal of the implants could injure neurovascular bundles to result in severe pain, paresthesia, and muscle paralysis.¹² There are also multiple reports of neuropathy resulting from the inappropriate removal procedure of implants.^{13–15} If implants migrate to a location that makes retrieval difficult, patients may be rendered infertile.

This narrative review aims to summarize the findings of different imaging and removal methods that are of relevance to interventional radiologists.

Discussion

Visualization Techniques

When presented with a nonpalpable implant, the first step is to establish visualization. The most common migration site of the implant is the axillary region, which is the first place that should be investigated if the implant cannot be palpated in the upper limb.^{16,17} General consensus among case studies is that true migration of the implant, beyond 2 cm from the insertion site, is rare if the insertion was performed properly and the implant can be palpated postinsertion.^{18,19}

When an implant is deeply inserted, it is critical that its location be confirmed before removal attempts are made. Several localization methods have been described for the visualization of non-radiopaque implants (i.e., Norplant, Implanon). The most common methods are ultrasound, radiography, compression film mammography, and computed tomography.^{20–26} The first reported ultrasound localization of subdermal implants showed that implants cast acoustic shadow with the sector scanner transverse to the long axis of the implants (→Fig. 1).²⁷ Should ultrasound and radiography fail to localize non-radiopaque implants, Lang et al suggested a modified needle localization technique similar to ones used for breast biopsy.²⁸ Other modified approaches for visualization include that of Rodriguez et al, who employed a modified mammographic technique with high resolution and contrast.²⁹ Kang and Hian Tan in Singapore have also had success in localization of the implants

Fig. 1 Gray-scale images demonstrate the hyperechoic implant (arrows) in transverse (a) and longitudinal (b) views and its characteristic posterior acoustic shadowing.

through the use of a paper clip as a marker, which is a simple and cost-effective technique.³⁰

Real-time fluoroscopic-guided localization and removal can only be accomplished if the radiopaque Nexplanon was used (any arm implant inserted in the United States after 2011 should be a radiopaque Nexplanon device; ►Fig. 2). In the case of non-radiopaque Implanon (inserted in the United States prior to 2011), ultrasound should be performed. Similar to ultrasound technique for the levonorgestrel implants, etonogestrel implants will cast a posterior acoustic shadow.^{31–33} In cases where ultrasound cannot locate the implant, MRI can be used to establish the implant location.³⁴ If both imaging methods fail to locate the implant, serum etonogestrel levels must be measured to confirm the presence or absence of the implant.³⁵ Etonogestrel levels can be requested via the implant manufacturer, Merck. Currently, radiopaque Nexplanon allows for easy visualization, even with radiography, which increases the likelihood of an injury-free implant removal.

Besides migration within the biceps, other more distant sites of migration include the ulnar nerve below the deep fascia, within the biceps muscle, next to the median nerve, and even to the pulmonary artery.³⁶ It is important to consider these distant locations if the implants cannot be located in the upper extremity. While migration to the pulmonary artery is rare and the patient may or may not experience symptoms associated with the implant emboli, it can be a life-threatening event and must be taken seriously. Searched literature demonstrated nine publications of pulmonary artery migration.^{37–45} Most cases of significant migration result from the implant being inadvertently inserted into the venous system. Typically, the implant then travels from the basilic vein and embolizes to the pulmonary arteries.⁴⁶ A chest X-ray should be considered early to avoid delays in diagnosis; if endothelialization of the implant occurs, removal may require surgery (or cause infertility and menstrual irregularities if not removed).

Removal Techniques

Once the implants are localized, they can be successfully removed. Tools used in a standard implant removal are

Table 1 Implant removal equipment and supplies

3-mL syringe
30-G needle to attach to syringe
2 mL 1 or 2% lidocaine with epinephrine
11 blade Scalpel
2 finest hemostat
Petrolatum ointment
Steri-Strips
Benzoin
Ethyl chloride

shown in ►Table 1. Techniques used in retrieving the older, Norplant implant include the standard removal method, the Pop-Out method, the Emory method, the U technique, and other modified techniques. The standard removal technique suggested by the manufacturer is a 4-mm incision made at the apex of the insertion site, then Crile and/or mosquito forceps used for extraction of the implants.^{6,47} The Pop-Out method does not require a hemostat, resulting in less anesthetic and a smaller incision; it can be advantageous in causing less tissue trauma and lower risk of fracture or implant damage.⁴⁸ The Emory method utilizes curved, 5-inch Halstead mosquito forceps to dissect subcutaneous tissue, which may be better for implants that are more difficult to remove.⁴⁸ The U technique uses modified vas deferens holding forceps to grasp the implants from the side rather than the tip.⁴⁸ The U technique results in fewer broken implants, shorter removal times, and fewer complications compared with the standard Norplant removal methods.⁶

If the newer implants are in the upper extremity, but deep within the biceps muscle fascia, a modified “U” technique with vasectomy clamps can be used for removal.^{49,50} With radiopaque Nexplanon, real-time fluoroscopic-guided removal utilizing a vasectomy clamp to grasp the implant can be successful⁵¹ (►Fig. 3). When the implant has been placed in or has migrated into an upper extremity vein and subsequently embolizes to the pulmonary artery, the most

Fig. 2 (a, b) Fluoroscopic-guided radiopaque Nexplanon (arrows) removal with hemostats.

Fig. 3 Fluoroscopic removal of Nexplanon with vasectomy clamps (a, arrow) and gross image of implant postremoval (b).

Fig. 4 (a) Gray-scale ultrasound image demonstrates hyperechoic implant. (b) Color Doppler ultrasound in same patient demonstrates the hyperechoic implant noted adjacent to vascular structures (color).

common removal method is endovascular retrieval. Specifically, retrieval is accomplished via selective catheterization of the artery with a gooseneck loop snare.⁵²

Nerve injuries can be associated with the removal of implants,^{53,54} so clinicians should discuss these risks with patients prior to attempting removal. Care should be taken to avoid potential injury to nearby neurovascular bundles (→**Fig. 4**). In these situations, a hook-wire marker method adopted from breast surgery can be employed.⁴ When the

implant is too close to the major neurovascular structures, the hook-wire can be inserted under ultrasound guidance to successfully remove deep-lying implants.⁴

Another method (by Rochon) to displace the implant from other structures is to inject lidocaine around the implant. This technique is analogous to injecting tumescent anesthesia around a sheath before thermally ablating saphenous veins. This allows not only additional anesthetic for the procedure but also ease in dissection and avoidance of other

Fig. 5 Injection of local anesthesia in a tumescent-like fashion (Rochon's technique) to displace the targeted implant. (a) Transverse image with hypoechoic fluid beneath implant (arrow). (b) Longitudinal image of lidocaine needle (arrow) on top of implant.

neurovascular structures (→Fig. 5). Dissection with fine hemostats under ultrasound guidance also aids in direct removal. It is important to evaluate all implants with ultrasound and/or radiography before performing the procedure. Using a combination of sharp and/or blunt dissection with image guidance almost always provides successful excision of the nonpalpable implants.

Though complications of implant removal are rare, the rising number of implantable contraceptives necessitates discussion on the topic. One should expect to see more cases of nonpalpable implants that require the assistance of interventional radiology for safe removal. Familiarizing oneself with the techniques described will allow for the proper and expedient management of issues relating to complications of implantable contraceptives.

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