

Special Topic

Betadine and Breast Implants

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Abstract

In the fourth quarter of 2017, the US FDA reviewed and approved a request by one of the breast implant manufacturers for a change in the Directions for Use (DFU) that removed warnings regarding the use of Betadine (povidone-iodine [PI] 10% solution, 1% available iodine [Purdue Frederick Company, Stamford, CT], also available in generic formulations [Aplicare, Inc., Meriden, CT]). Previously, in 2000, there were concerns by the FDA that PI would degrade the silicone elastomer shell. This change in the DFU represents an important advance that will benefit patients through the permitted use of PI to reduce the risk of bacterial contamination of implant surfaces. What was formerly an off-label practice can be openly practiced by plastic surgeons as an anti-infective and biofilm-mitigation strategy. PI has an ideal spectrum effect for gram-positive and gram-negative organisms. Gram-positive organisms have been linked to capsular contracture and gram-negative *Ralstonia picketti* to breast implant-associated anaplastic large cell lymphoma (BIA-ALCL). *R picketti* is resistant to aminoglycoside antibiotics, but it is susceptible to at least a 50% solution of PI. We believe that the strategy of antisepsis and biofilm mitigation is an integral part of a contemporary approach for breast augmentation. This is beneficial regarding reduction of the risk of surgical infection, capsular contracture, and BIA-ALCL. Outcome data so far indicate that antibiotics/anti-infectives seem to reduce the incidence of these adverse events that lead to reoperation and increased costs. It behooves plastic surgeons to take all actionable steps that enhance the quality of breast implant outcomes and reduce the rate of reoperation.

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In the fourth quarter of 2017, the US FDA reviewed and approved a request by one of the breast implant manufacturers for a change in the Directions for Use (DFU) that removed warnings regarding the use of Betadine (povidone-iodine [PI] 10% solution, 1% available iodine [Purdue Frederick Company, Stamford, CT], also available in generic formulations [Aplicare, Inc., Meriden, CT]). Formerly, in 2000, there were concerns by the FDA that PI would degrade the silicone elastomer shell. In response to this, Adams developed a non-Betadine containing triple antibiotic solution (NB-TAB) (50,000 units bacitracin, 1 gm cefazolin, 80 mg gentamicin, 500 cc NS) as an alternative to the same authors original recommendation for Betadine Triple Antibiotic (Betadine-Triple) (50 cc Betadine solution, 50,000 units bacitracin, 1 g cefazolin, 80 mg gentamicin, 500 cc normal saline) or 50-50% Betadine solution and normal saline.^{1,2} With the recent change in DFU, the use of Betadine is once again permitted.

We believe that this change in the DFU represents an important advance that will benefit patients through the permitted use of PI to reduce the risk of bacterial contamination of implant surfaces. What was formerly an off-label practice can be openly practiced by plastic surgeons as an anti-infective and biofilm-mitigation strategy when utilizing breast implants and tissue expanders.

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Bacterial Contamination Risks

All implanted devices are at risk for bacterial contamination.³ Bacterial surface contamination of implants (smooth and textured surfaces) has been implicated as a cause of infection, capsular contracture, double capsules, and late-term breast implant-associated anaplastic large cell lymphoma (BIA-ALCL).³⁻¹⁸

Gram-positive organisms have been linked to capsular contracture and gram-negative *R picketti* to BIA-ALCL.^{6,19-21} *R picketti* is resistant to aminoglycoside antibiotics, but susceptible to at least a 50% solution of PI.^{22,23}

Methods to Reduce Capsular Contracture

The concept of iodine as an antibacterial agent has existed for 150 years.²⁴⁻²⁶ There have not been reports of acquired resistance or cross-resistance to iodine.²⁶ Iodine appears to have excellent efficacy as a biofilm-mitigation agent. The iodine inhibits vital bacterial structures and enzyme systems.²⁶

Iodine has a broader range of antibacterial effect than antibiotics. Moreover, with iodine, there is an ideal spectrum effect for gram-positive and gram-negative organisms. PI is universally available and inexpensive, and it is ideal for applications such as breast implants and tissue expander surgery pocket irrigation.

Credit must be given to Boyd Burkhart, MD, for describing in the 1980s the use of implant pocket irrigation with Betadine (PI) to reduce capsular contracture.²⁷⁻³⁰ Other investigators have found similar benefits.^{17,18} While these were not large-scale controlled studies, evidence regarding the benefit of pocket irrigation with PI was established. The senior author's (M.L.J.) personal experience with this approach throughout his use of breast implants to the present (40 years) reveals zero perioperative infection incidence in primary breast augmentation patients and a low long-term capsular contracture incidence of <2.5%. Similarly, the combined experience of 8 surgeons who reviewed their experience with a comprehensive approach for 14 Point Plan biofilm mitigation (Betadine-Triple, NB-TAB, or at least a 50% solution of PI) in macrot textured implants demonstrated zero incidence of BIA-ALCL with a mean follow-up of 11.5 year in 22,000 patients.⁴

Credit also must be given to Thomas Wiener, MD, for being a tireless advocate of the use of Betadine (PI) to reduce capsular contracture.^{17-18,31-32} Despite numerous communications with the US FDA by Dr. Wiener circa 2005, the restriction on the use of Betadine and breast implants continued for another 12 years.³¹

While the use of PI as an antibacterial to reduce capsular contracture is nothing new, it has found use as a simple, cost-effective solution to manage surface contamination with both gram-positive and gram-negative

organisms, including *R picketti* in both smooth and textured surface implants and expanders. It can be utilized as an irrigation solution or as a lubricant (gel formulation). PI is supplied in small bottles that are packaged in sterile surgical skin prep kits (solution, gel, or scrub). We believe that this approach of a one-time use of pre-packaged sterile PI is safer than decanting PI onto the surgical field from a bottle that has been opened multiple times.

For PI to be effective, the concentration should be a 50% concentration in an irrigation solution.²³ Full-strength PI in one report has been shown to inhibit 100% of fibroblasts in vitro.³³ While some in vitro studies have suggested that PI may have a measure of cytotoxic effect, no consistent deleterious effects on various measures of wound healing have been demonstrated in in vivo studies, particularly at lower PI concentrations. PI showed gram-positive and gram-negative activity without fibroblast inhibition.³⁴ To lower the PI concentration, surgeons have utilized PI-triple antibiotic (Betadine Triple Antibiotic) and Non-PI-Triple Antibiotic. These irrigations have been shown to lower capsular contracture tenfold.^{8,10,12}

Concerns have been raised regarding the potential toxicity and negative wound-healing effects of PI-detergent formulation involving rabbit articular tissue.³⁵ Data from other studies, pertaining to chronic wounds, do not show deleterious effects on wound healing.^{36,37} There has not been a definite study that has demonstrated that PI produces a negative clinical outcome with breast implants or tissue expanders. With breast implants and tissue expanders, PI is utilized as a one-time pocket irrigation rather than being chronically utilized in wound-management scenarios.

Given the improved gram-negative coverage for *R picketti* with PI-containing irrigations, our preference is to utilize PI-TAB or a 50-50% mixture of PI in normal saline. PI appears effective in penetrating existing biofilms.²⁶ PI should never be utilized within the lumen of saline-filled breast implants or tissue expanders, because it may produce delamination of the implant shell.³⁸ There is no published data regarding how pocket irrigation with PI affects tissue integration with alloplastic soft tissue support materials.

Stabilized hypochlorous acid is being studied as an antibacterial irrigation and biofilm-mitigation agent. PI has been shown to be superior to 0.025% hypochlorous acid (PhaseOne, Integrated Healing Technologies, Franklin, TN, USA, "HOCl") for the inhibition and eradication of *Staphylococcus aureus* biofilm in an in vitro study.³⁹ The authors theorized that the presence of blood or protein apparently reduced the effectiveness of HOCl. A second study by Brindle et al⁴⁰ demonstrated that HOCl had excellent efficacy against planktonic and biofilm bacteria, including *R picketti*.

We believe that the strategy of utilizing antibacterial agents for biofilm mitigation is an integral part of a contemporary approach for breast augmentation along with the other actionable steps that are outlined in The 14 Point

Table 1. Surgical 14-Point Plan for Breast Implant Placement (reprinted with Permission from Wolters Kluwer Health, Inc.⁴)

1. Use intravenous antibiotic prophylaxis at the time of anesthetic induction
2. Avoid periareolar/transaxillary incisions; these have been shown in both laboratory and clinical studies to lead to a higher rate of contracture
3. Use nipple shields to prevent spillage of bacteria into the pocket
4. Perform careful atraumatic dissection to minimize devascularized tissue
5. Perform careful prospective hemostasis
6. Avoid dissection into the breast parenchyma
7. The use of a dual-plane pocket
8. Perform pocket irrigation with triple antibiotic solutions or Betadine (povidone-iodine [PI] solution) <ol style="list-style-type: none"> i. Perform entire pocket irrigation with precisely mixed PI-TAB solution or 50% (1:1 dilution) or stronger Betadine. Completely envelop the pocket, prep the skin around the incision, and preemptively dip and clean any instruments used in the pocket in the solution. ii. Do not use single-agent antibiotic (Cefazolin) irrigation or Bacitracin irrigation, because they do not work effectively (incomplete coverage spectrum) iii. Recommended irrigation (see Appendix A)
9. Take steps to minimize skin-implant contamination. There are multiple methods to minimize skin contamination including: <ol style="list-style-type: none"> i. Adequate incision size ii. Re-prep skin with antibiotic solution or skin prep iii. Skin barrier (eg, Tegaderm) iv. Use of an insertion sleeve
10. Minimize implant open time and replacement of implant or sizers
11. Change surgical gloves prior to handling and use new or cleaned instruments and drapes
12. Avoid utilizing a drainage tube, which can be a potential site of entry for bacteria
13. Use a layered closure
14. Use antibiotic prophylaxis to cover subsequent procedures that breach skin or mucosa

Plan (Table 1). These steps are beneficial in reducing the risk of surgical infection, capsular contracture, and BIA-ALCL. Outcome data so far indicate that antibiotics/antibacterial agents seem to reduce the incidence of these adverse events that lead to reoperation and increased costs. It behooves plastic surgeons to take all actionable steps to enhance the quality of breast implant outcomes and reduce the rate of reoperation.

The 14 Point Plan is compatible with process engineering methods such as the Toyota Production System and Lean Manufacturing as applied to breast augmentation, in which quality improvement is continuous and work is described as a series of interconnected steps.⁴¹ A previous study by Tebbetts and Adams⁴² described the process of breast augmentation as a series of connected events rather than just a single surgical procedure. Credit must be given to Dr. Adams for describing the four sequential steps that optimize the surgical outcomes. The process of breast augmentation is comprised literally of hundreds of steps.

CONCLUSION

For the future, we recommend that surgeons document their practices to manage biofilm contamination and its consequences both prior to surgery in preoperative discussions with patients and within the operative report. Outcome data collection regarding the quality of outcomes, reoperation, and patient satisfaction will be key to keeping breast implants available for patients. Moreover, it emphasizes that plastic surgeons are committed to solving the relationship between biofilm and BIA-ALCL.

Supplementary Material

This article contains supplementary material located online at www.aestheticsurgeryjournal.com.

Disclosures

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