

Breast Augmentation, Antibiotic Prophylaxis, and Infection: Comparative Analysis of 1,628 Primary Augmentation Mammoplasties Assessing the Role and Efficacy of Antibiotics Prophylaxis Duration

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Abstract

Background Infections after augmentation mammoplasty are not uncommon, and prophylactic antibiotics are routinely administered to minimize infection. However, there is paucity of information on the relationship between the length of prophylaxis cover and its benefits in primary augmentation mammoplasty. A retrospective analysis of different antibiotic cover regimens, their effectiveness in preventing infections, and the management of infection in established cases is reviewed.

Methods A retrospective chart analysis of periprosthetic infections in primary augmentation mammoplasties performed over the past 10 years was conducted. Periprosthetic infection was determined by the presence of pain, swelling, redness, and discharge. Each breast was taken as an individual unit in 1,628 patients, and data for 3,256 breasts were analyzed. The patients had their augmentation in the partial submuscular plane (214 breasts in 107 patients), the subglandular plane (1,548 breasts in 774 patients), and the muscle-splitting biplane (1,494 breasts in 747 patients). All the patients had soft round cohesive gel silicone implants. Of the 3,256 implants, 3,218 were textured, and 38 were smooth surfaced. The patients received antibiotics as a single intravenous dose of cephalosporin (474 breasts in 237 patients), a single intravenous dose plus an oral dose for 24 h (344 breasts in 172 patients), or a single intravenous dose plus an oral course for 5 days (2,438 breasts in 1,219 patients). Infection was recorded as superficial (e.g., wound breakdown, stitch extrusion, stitch abscess) or deep (periprosthetic). The patients with established periprosthetic

infections, determined clinically by the presence of pain, discharge, swelling, and redness of the breasts, were managed either conservatively using antibiotics, passive wound drainage, and healing of the wound with secondary intention or by explantation and replacement after 3 to 4 months. In selected cases of periprosthetic infection, the implants were removed after a course of antibiotics and negative swab cultures. The cavity was washed thoroughly with betadine and saline, and new implants were simultaneously reimplanted.

Results The incidence of infection was lowest with a single perioperative dose of intravenous antibiotic compared with a combination of intravenous and oral antibiotics. Superficial infection was seen in 38 breasts (all unilateral), with an incidence of 1.2%, and periprosthetic infection was observed in 17 breasts (13 unilateral and 2 bilateral), giving an infection incidence of 0.52% ($p = 0.002$). In patients with a single intravenous dose of antibiotic, superficial and periprosthetic infection was seen in four breasts (0.8%) and no breasts, respectively. The difference was not significant ($p = 0.13$). The patients receiving a single intravenous antibiotic and a 24-h oral antibiotic had superficial and periprosthetic infection rates of 2.3% (8 breasts) and 0.3% (1 breast), respectively, and the difference between the two sub-groups was significantly higher ($p = 0.04$). The patients receiving an intravenous antibiotic and 5 days of oral antibiotics had superficial and periprosthetic infection rates of 1.1% (26 breasts) and 0.65% (14 breasts), respectively. The difference between the two subgroups was not significant ($p = 0.09$). Of the 17 periprosthetic infections in 15 patients (13 unilateral and 2 bilateral), 11 breasts (1 bilateral and 9 unilateral) were treated conservatively using antibiotics, passive drainage, and wound healing with secondary intention. Capsular contracture developed in two of the conservatively treated breasts, requiring capsulotomies with change of implants. Of the six periprosthetic infections

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in six patients, requiring surgical intervention, two implants were treated using explantation with immediate replacement after a course of antibiotics and a negative culture, and two implants were explanted followed by reimplantation later. One patient had both implants removed after unilateral infection, and no reimplantation was performed. One patient had a bilateral infection. In this case, one implant was explanted and the other was treated conservatively. The patient had bilateral reimplantation 6 months later, and bilateral Baker 4 capsular contracture developed in both breasts within 6 months. No other complications were seen in the patients who underwent surgery.

Conclusion A single dose of intravenous antibiotic is adequate for prophylaxis in breast augmentation surgery, and the extra duration of antibiotic cover does not result in reduced superficial or periprosthetic infections. Infection can be managed in more than one way depending on the nature, degree, and extent of infection.

Keywords Antibiotic prophylaxis · Breast implant infection · Muscle-splitting augmentation · Periprosthetic infection · Sterile pus

Complications after augmentation mammoplasty are few and can present early or late. Common early complications are hematoma, seroma, infection, Mondor's disease, and wound breakdown. Common late complications include capsular contracture, implant rupture, and asymmetries secondary to implant malplacement or displacement.

Although early complications are seen less frequently than the late varieties, the management of these early complications nevertheless often requires surgical intervention. Mondor's disease [1, 2], or thrombophlebitis of the thoracoepigastric vein, is an early complication managed conservatively. However, infection and hematoma often necessitate surgical intervention. The accepted determination of periprosthetic infection generally is the presence of pain, swelling, redness, and discharge. Although the incidence of infection generally is low, it can be challenging to manage. The reported incidence varies between 1.1% and 2.5% [3–5].

The management of periprosthetic infection has evolved over time from device removal and delayed replacement [6] to passive wound drainage and healing with secondary intention [4]. In selected cases, implants can be salvaged by capsulectomy, debridement, pulse lavage, and device exchange [7]. Antibiotics are almost always administered regardless of the method chosen for management, and a wound swab for microbiologic testing is considered mandatory.

The use of prophylactic antibiotics has increased considerably in the past 35 years [8, 9]. This increase is not

supported by evidence-based medicine or carefully controlled, prospective, randomized trials [10]. Although the wound in augmentation mammoplasty is categorized as clean [11], insertion of the prosthesis is an indication for prophylactic antibiotics [12, 13]. The use of prophylactic antibiotics in augmentation mammoplasty also is substantiated by the presence of *Staphylococcus epidermidis* in 66% of the nipple secretions [4]. On the other hand, when two groups of patients, one with and one without prophylactic antibiotic, were compared, no significant difference of infection was found between the them [13]. Furthermore, a low infection rate of 2.2% was seen in 899 patients who underwent augmentation mammoplasty without receiving any prophylactic antibiotic [4].

The current retrospective study involved data analysis of 1,628 bilateral primary augmentation mammoplasties (3,256 breasts) by a single surgeon. All the patients had prophylactic antibiotics, and three groups were identified based on the duration of the antibiotics received, and the incidence of infection, both superficial and deep, was analyzed between these groups. Data analysis showed that a single intravenous dose is more than adequate for prophylaxis, and that an extra duration of antibiotic cover does not help to reduce the incidence of infection. The incidence of infection was higher when the antibiotic cover was prolonged in the postoperative period, but the difference was not statistically significant.

The study also reviewed the outcome of different strategies for the management of superficial and periprosthetic infections and their outcome in primary augmentation mammoplasties.

Methods

A retrospective chart analysis of periprosthetic infections in primary augmentation mammoplasties performed in the past 10 years was conducted. Periprosthetic infection was determined by the presence of pain, swelling, redness, and discharge. Each breast was taken as an individual unit in 1,628 patients, and data from 3,256 breasts were analyzed. Augmentations were in the partial submuscular plane (214 breasts in 107 patients), subglandular plane (1,548 breasts in 774 patients), and muscle-splitting biplane (1,494 breasts in 747 patients).

All the patients had soft round cohesive gel silicone implants. Of the 3,256 implants, 3,218 were textured and 38 were smooth surfaced. The patients received antibiotics as a single intravenous dose of cephalosporin (474 breasts in 237 patients), a single intravenous dose plus an oral dose for 24 h (344 breasts in 172 patients), or a single intravenous dose plus an oral course for 5 days (2,438 breasts in 1,219 patients). Infection was recorded as superficial (e.g.,

wound breakdown, stitch extrusion, stitch abscess) or deep (periprosthetic).

Patients with established periprosthetic infections, determined clinically by the presence of pain, discharge, swelling, and redness of the breasts, were managed either conservatively using antibiotics, passive wound drainage, and healing of the wound with secondary intention or by explantation and replacement after 3 to 4 months. In selected cases of periprosthetic infection, implants were removed after a course of antibiotics and negative swab cultures. The cavity was washed thoroughly with betadine and saline, and new implants were simultaneously reimplanted.

Results

The overall incidences of superficial and periprosthetic infection were 1.16% and 0.52%, respectively (Table 1). In the patients with a single intravenous dose of antibiotic, superficial infection was seen in four breasts (0.8%) and periprosthetic infection in no breasts, and the difference was not significant ($p = 0.13$). The patients receiving a single intravenous antibiotic and a 24-h oral antibiotic had a superficial infection in eight breasts (2.3%) and a periprosthetic infection in one breast (0.3%), and the difference between the two subgroups was significant ($p = 0.04$). The patients receiving intravenous antibiotic and 5 days of oral antibiotics had superficial and periprosthetic infections, respectively, in 26 breasts (1.1%) and 14 breasts (0.65%),

and the difference between these two subgroups was not significant ($p = 0.09$) (Table 2a, b).

A comparison between group 1, with intravenous antibiotic alone and the lowest infection rate, and groups 2 and 3 showed no statistical difference between the rates for superficial and periprosthetic infections (Table 2a, b).

Of the 17 periprosthetic infections in 15 patients (13 unilateral and 2 bilateral), 11 breasts (1 bilateral and 9 unilateral) were treated conservatively with antibiotics, passive wound drainage, and wound healing with secondary intention. Capsular contracture developed in two of the conservatively treated breasts, requiring capsulotomies with a change of implants.

Of the six periprosthetic infections (6 patients) requiring surgical intervention, two implants were treated using explantation with immediate replacement after a course of antibiotics and negative culture, and two implants were explanted followed by reimplantation later. One patient had both implants removed after unilateral infection and did not proceed with reimplantation. In the remaining patient, who had bilateral infection, one implant was explanted and the other was treated conservatively. The patient had bilateral reimplantation 6 months later, and bilateral Baker 4 capsular contracture developed in both breasts within 6 months. No other complications were seen in the surgically treated patients (Table 2a, b).

Discussion

An acceptable infection rate of 2.2% was reported in a large series of 899 patients undergoing augmentation mammoplasty. No patients in the series had antibiotic prophylaxis [4]. In another study, a group of 60 patients receiving antibiotic had no infections compared with an infection rate of 0.7% in a group of 132 patients who received no prophylactic antibiotics. The difference between the two groups was not significant [13].

Table 1 Overall incidence of superficial and periprosthetic infection in all three groups (n = no. of breasts)

No. of breasts	Superficial wound infections n (%)	Periprosthetic infections n (%)
3,256	38 (1.16)	17 (0.52)

Table 2 Relationship of antibiotic cover duration to incidence of infection in three groups studied (n = no of breasts)

Antibiotic regimen	Superficial wound infection n (%)	Periprosthetic infection n (%)	p Value
<i>a</i>			
Single intravenous dose antibiotic ($n = 474$)	4 (0.8)	0 (0)	0.13
Single intravenous dose + 5 days of oral antibiotic ($n = 2,438$)	26 (1.1)	16 (0.65) (12 unilateral, 2 bilateral)	0.09
p Value	0.61	0.15	
<i>b</i>			
Single intravenous dose antibiotic (474)	4 (0.8)	0 (0)	0.13
Single intravenous + 24-h oral antibiotic ($n = 344$)	8 (2.3)	1 (0.3)	0.04
p Value	0.08	–	

Augmentation mammoplasty is classified as a clean procedure [11]. However, the use of a prosthesis [12] and the presence of *Staphylococcus epidermidis* in the majority of nipple secretions [4] justifies the use of prophylactic antibiotics with this particular procedure. The choice of prophylactic antibiotic cover varies from surgeon to surgeon and is selected primarily for its efficacy against the majority of the pathogens identified in microbiologic tests.

In the current study, cephalosporin was the antibiotic of choice because of its efficacy against most reported pathogens, its longer plasma half-life, and its easy twice-daily dose when given in oral form. Despite the lack of scientific evidence [11] and the lack of controlled, prospective randomized trials [10], the use of antibiotic prophylaxis has almost doubled in the past 40 years [8, 9]. An infection rate of 2.8% is considered acceptable for overall plastic surgical procedures [9]. Infection rates of 0.7% [13] and 2.2% [4] without antibiotic prophylaxis clearly indicate a lack of understanding about this much discussed topic in plastic surgery.

The possibility of a possible legal consequence has been responsible for the often injudicious use of antibiotics [9]. A lack of clarity on the topic and the absence of large prospective studies in the literature have resulted in an extra cost of the package to the patient, *Clostridium difficile* colitis and the emergence of resistant organisms are the outcome of prolonged antibiotic prophylaxis use [10].

An infection after primary mammoplasty is uncommon [3–5]. Although it can be managed conservatively [4, 7] (Fig. 1a–g), it often requires a surgical intervention, which can vary from implant removal with later replacement [6] to capsulectomy, debridement, pulse lavage, and implant placement as a single-stage procedure [7] (Fig. 2a–g). These infections almost always present with the classical symptoms of erythema, swelling, discharge, and pain [4]. However, subclinical infections can be difficult to diagnose in the absence of such overt clinical signs of infections, and routine microbiologic swabs often show negative results [14]. These organisms, usually *Staphylococcus epidermidis*, are adhered to implants in sessile form and covered by a biofilm. These subclinical infections, especially those with significant capsular formation, cannot be detected unless specimens are tested by sensitive broth cultures [14].

Clinical infection after mammoplasty usually presents as superficial or deep. Superficial infections or wound healing problems commonly are a combination of different scenarios that include stitch extrusion, small localized stitch abscess, small wound breakdown, or delayed healing. Although the incidence is twice as common and significantly higher (Table 2), problem is almost always limited to the wound and do not communicate with the implant pocket. These superficial wound problems need to be distinguished from periprosthetic infections because

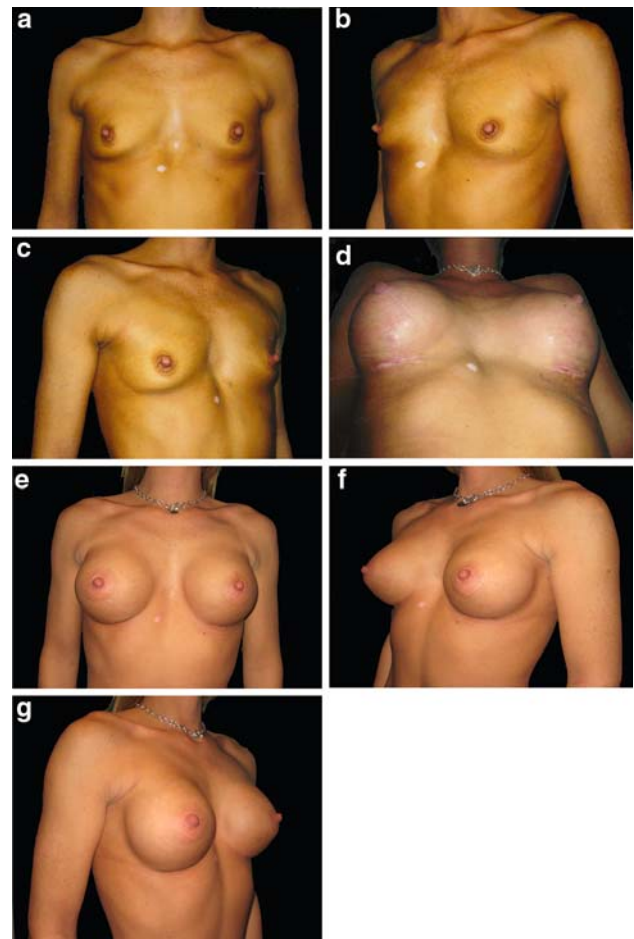


Fig. 1 a–c preoperative views of a patient with hypoplastic breasts. d postoperative presentation of bilateral infection with complete wound breakdown. e–g results 6 months after full recovery

conservative treatment of the superficial infections almost always leads to a full recovery without capsular contraction. A wound swab for culture and sensitivity is highly recommended for these superficial infections, which invariably show skin flora.

Management of periprosthetic infection is entirely different and often requires a surgical intervention. These surgical interventions include either explantation with replacement later as a staged procedure [6] or salvage of the infected prosthesis in selected cases, which can be performed with capsulectomy, debridement, pulse lavage, and immediate replacement with an implant [7]. Salvage of the implant after this approach is possible in selected cases, in contrast with a rat model study showing 100% dehiscence and implant exposure when a new sterile implant was reinserted immediately. The study also showed that a delay of even a few hours could reduce the exposure significantly [15].

In the current series, two implants were salvaged with immediate replacement (Fig. 2a–g). Both of the patients

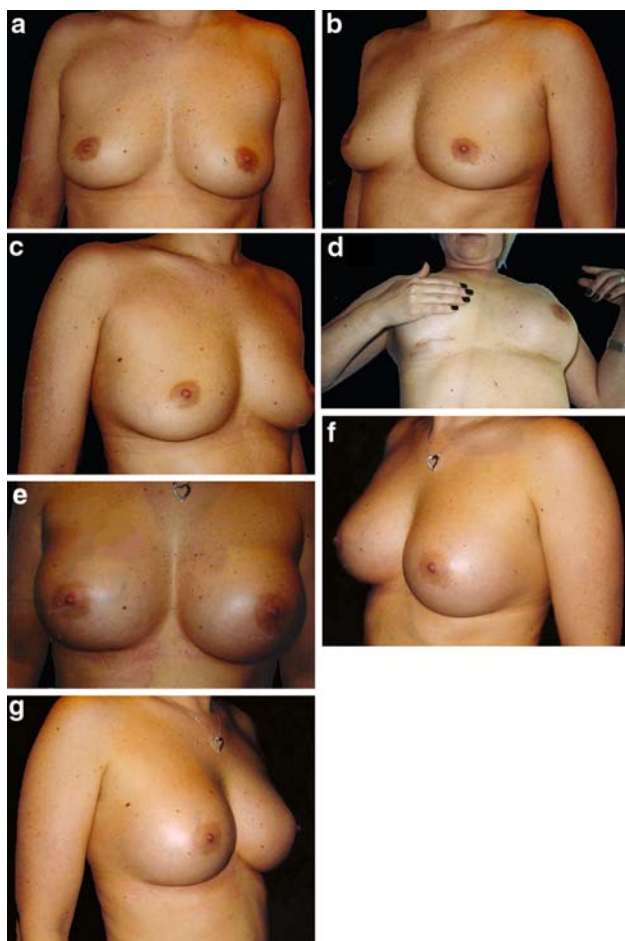


Fig. 2 a–c preoperative views of a patient requesting augmentation mammoplasty. d Infection of the right breast, treated with antibiotics and regular microbiologic swabs for culture and sensitivity. e–g Final result. After cessation of discharge together with negative microbiologic growth in culture, the breast pocket was washed with betadine and normal saline, and a new implant was placed with a drain

had a course of antibiotic, and once the repeat culture showed no growth on the microbiology report, the implants were removed, the pocket washed out with povidine iodine and saline, and sterile implants reinserted with a drain. The drain was left for at least 2 days to allow inflammatory exudates to be drained. No pulse lavage or debridement was performed, and both patients had full recovery without repeat infection or capsular contracture.

Courtiss et al. [4] reported a 45% success rate using conservative treatment, but nearly one-third of their patients experienced capsular contracture later. In the current series, the incidence of capsular contracture after conservative treatment was 22%. Courtiss et al. [4] reported a 66% rate of culture sensitivity for coagulase-negative *Staphylococcus epidermidis* in nipple secretions. Pajkos et al. [14] reported a rate of 61% for *Staphylococcus epidermidis* out of 66.7% of coagulase-negative *Staphylococcus* isolated in the tested samples. However, the most

Table 3 Microbiologic results for microbiologic culture tests of wound swabs

	Breasts
<i>Staphylococcus aureus</i>	7
Skin flora (<i>Staphylococcus epidermidis</i>)	4
Lactose fermenting coliform	1
<i>Acinetobacter lwoffii</i>	1
No growth	4

common microbiologic organism responsible for peri-prosthetic infection is *Staphylococcus aureus* [4], and in the current study, *Staphylococcus aureus* was the single most isolated organism (Table 3).

Infections resulting from nontuberculous mycobacteria may have all the hallmarks of infection, with negative routine bacteriologic results, and these infections are resistant to routine antibiotic treatment. High suspicion and acid fast bacilli (AFB) staining must be considered in these cases for early antituberculous therapy [16, 17]. Sterile pus also may be seen after augmentation mammoplasty without any bacterial growth in microbiologic cultures and does not present with classical hallmarks of infection. The buildup of this sterile pus usually manifests as an autoinflated breast. The negative routine tests are postulated as due to the noninfectious inflammatory response to leaked silicone. These swellings, presenting early or late, are considered an early marker of implant rupture and managed with a single-stage procedure [18, 19].

Pajkos et al. [14] also reported negative swab cultures when routine samples were obtained at the time of explantation. However, when the samples of the capsules and implants from the same subjects were prepared with sensitive broth cultures, 50% yielded positive organisms in cultures. The negative cultures for routine swabs are due to a protective layer of biofilm covering the sessile form of the organism adhered to the surface of the implants [14].

In the current study, 39.6% of augmentation mammoplasties had drains, and 10 (58.8%) of 17 breasts with infection had drains. Similarly, 651 (40%) of the sample patients were smokers, and of 15 patients (13 unilateral and 2 bilateral) who had infection, 10 (66.7%) were smokers. The results were not statistically analyzed but strongly suggest that drains and smoking are important predisposing factors of infection.

Perouse Perthese textured implants (Perouse Plastie, Bornel, France) were the most common implants used (75.5%), and their involvement in periprosthetic infection (82%) was a little higher than their percentage of usage in the series. Mentor (Mentor Medical Systems, Santa Barbara, CA, USA), Inamed (Inamed Aesthetics, Arklow, County Wicklow, Ireland), and Perous Perthese smooth surface

Table 4 Relative distribution of make and type of implant together with relative involvement in periprosthetic infection

Make (% and no. of implants used)	Relative distribution of the periprosthetic infection in each group (%)
Mentor cohesive 1 round textured implants (2%, $n = 66$)	0
Inamed CML and CMH round textured implants (7.7%, $n = 250$)	0
Perouse Perthese 510 T smooth-surfaced round implants (1.1%, $n = 38$)	0
Perouse Perthese round micro-textured implants (75.5%, $n = 2,458$)	82.3
Poly Implant Prothese round textured implants (8.7%, $n = 284$)	11.8
Nagor GFX round textured implants (4.9%, $n = 160$)	5.9

implants formed 11% (354) of the total pool of implants used (3,256) and were not involved in any periprosthetic infections (Table 4).

Conclusion

A single dose of intravenous antibiotic is adequate for prophylaxis in breast augmentation surgery, and an extra duration of antibiotic cover does not provide a reduction in superficial or periprosthetic infections. Infection can be managed in more than one way depending on the nature, degree, and extent of the infection.

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