The role of topical antibiotics used as prophylaxis in surgical site infection prevention

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Compared with systemic antibiotic therapy, the topical or local delivery of an antibiotic has many potential advantages. However, local antibiotics at the surgical site have received very limited approval in any of the surgical prophylaxis consensus guidelines that we are aware of. A review of the literature was carried out through searches of peer-reviewed publications in PubMed in the English language over a 30 year period between January 1980 and May 2010. Both retrospective and prospective studies were included, as well as meta-analyses. With regard to defining ‘topical’ or ‘local’ antibiotic application, the application of an antibiotic solution to the surgical site intraoperatively or immediately post-operatively was included. A number of surgical procedures have been shown to significantly benefit from perioperative topical prophylaxis, e.g. joint arthroplasty, cataract surgery and, possibly, breast augmentation. In obese patients undergoing abdominal surgery, topical surgical prophylaxis is also proven to be beneficial. The selective use of topical antibiotics as surgical prophylaxis is justified for specific procedures, such as joint arthroplasty, cataract surgery and, possibly, breast augmentation. In selective cases, such as obese patients undergoing abdominal surgery, topical surgical prophylaxis is also proven to be beneficial. Apart from these specific indications, the evidence for use of topical antibiotics in surgery is lacking in conclusive randomized controlled trials.

Keywords: perioperative antibiotics, healthcare-associated infections, abdominal surgery, cardiothoracic, orthopaedic

Background

Surgical site infection (SSI) accounts for 20% of all healthcare-associated infections.1 Approximately 5% of patients undergoing surgery develop SSI.2 SSI results in failure of wound healing with subsequent increased treatment costs,3 a greater likelihood of admission to the intensive care unit, prolonged hospital stay and higher post-operative mortality.4 In particular, studies have demonstrated an extra 7–10 days inpatient stay in those with SSI.5–6 The associated hospital cost has been estimated at USS3937 per infected patient.6 Therefore, there is interest in SSI and its prevention amongst surgeons and amongst many other healthcare professionals, because of the increased patient morbidity and the associated financial burden.

There are many interventions advocated to reduce SSI, including pre-operative assessment to optimize underlying disease such as diabetes mellitus, aseptic techniques in the operating theatre and the use of systemic prophylactic antibiotics.7–9 Amongst the many interventions advocated to prevent SSI, the effectiveness of pre-operative intravenous administration of antibiotic prophylaxis has been extensively studied and has been shown to be effective.10–15 Surgical practice often includes the use of topical or local antimicrobial agents applied to the operative site to minimize post-operative surgical infections, especially SSI. Compared with systemic antibiotic therapy, topical or local delivery of an antibiotic has many potential advantages, as well as some disadvantages, as outlined in a review by Lipsky and Hoey.16 The benefits of local application include high and sustained concentrations at the site of infection where local physiological changes may hinder the efficacy of systemic antibiotics.16–19 Other benefits include the limited potential for systemic absorption and toxicity, reduced volumes of antibiotic use, and, possibly, less potential for the development of antibiotic resistance (as there is likely to be less of an effect on, e.g. bowel flora).16 Novel agents that are not available systemically may also be used.16

While local hypersensitivity or contact dermatitis reactions and interference with local wound healing may be problematic, a major disadvantage of local antibiotics is that there are no specific efficacy criteria for agents in this setting that have been standardized and approved by any official oversight agency for evaluating their efficacy.16 Antibiotics may be delivered locally in the form of intraoperative washes or injections, locally applied lotions, solutions, powders, gels, creams or ointments, and antibiotic-impregnated beads or collagen implants. The more commonly used antibiotics include cephalosporins, aminoglycosides, glycopeptides, chloramphenicol and bacitracin. The pharmacodynamic/pharmacokinetic profiles vary depending

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on the antibiotic, the dose and the method of delivery. Consequently, it is difficult to establish which antibiotic to use, as well as how much, for how long and in what form, for prophylaxis in a particular type of surgery. Comparisons of studies of local antibiotics in certain surgical settings may also be difficult given the variation in agent, dose and formulation. For this and other reasons, local antibiotics at the surgical site have received very limited approval in any of the surgical prophylaxis consensus guidelines that we are aware of.

We reviewed the literature to determine what evidence exists regarding the range of agents used, the indications for their use and the efficacy of topical antibiotics in the prevention of SSI.

Methods
A detailed review of the literature was carried out through searches of peer-reviewed publications in PubMed in the English language over a 30 year period between January 1980 and May 2010. Terms used in the search included ‘topical antibiotics’, ‘local antibiotics’, ‘intra-operative antibiotics’, ‘surgical prophylaxis’, ‘antibiotic prophylaxis’, ‘surgical site infection’, ‘surgical infection’, ‘healthcare associated infection’, ‘surgical infection prevention’ and ‘wound infection’. We focused on publications dealing with the intraoperative or immediate post-operative application of topical or local antibiotics for SSI prophylaxis. With regard to defining ‘topical’ or ‘local’ antibiotic application, the application of an antibiotic solution to the surgical site intraoperatively or immediately post-operatively was included. Studies in a setting of already infected surgical wounds or the treatment of established infection were excluded. Both retrospective and prospective studies were included, as well as meta-analyses. Case reports and review articles were excluded.

The review was focused solely on the use of topical or local antibiotics as surgical prophylaxis in SSI prevention only. In addition, studies assessing antibiotic-impregnated cement, beads or gels for local application were included. However, publications on studies of nasal mupirocin (usually used to reduce post-operative infections due to Staphylococcus aureus), antiseptics, antibiotic-impregnated devices (e.g. ventriculo-peritoneal shunts), grafts or suture materials were excluded, as these are specifically advocated and used to prevent device-related infections and not just SSI.

Results
Abdominal surgery

There is good evidence that systemic antibiotic prophylaxis reduces wound infection rates and major prophylaxis guidelines recommend that it is given. 

Previous studies of topical cephalosporin use in gallbladder surgery reported that topical antibiotics should not be used on their own as prophylaxis, especially in patients at high risk of SSI. In 1992, a Japanese study confirmed that antibiotic concentrations in the peritoneum were protective against those bacteria commonly causing SSI in these patients. The study prospectively followed two patient groups to observe SSI rates. One group received local intraoperative application of latamoxef, cefotaxime, cefotiam or cefamandole to the surgical site alone, compared with a control group receiving the same prophylaxis but intravenously. On clinical follow-up, no significant differences were observed between patients who were given topical antibiotics and those administered intravenous prophylaxis. However, this study was limited by sample size: only 80 patients were studied and, therefore, the study was not powerful enough to detect a significant difference.

In 2009, a study comparing intravenous and local antibiotic prophylaxis in inguinal hernia mesh repair reported that local intraoperative administration of gentamicin had comparable efficacy in preventing SSI to intravenous gentamicin administration. However, the overall SSI rate in these two groups was high (6.9%) and the patient number small, with only 202 study participants. A larger randomized controlled trial has questioned the need for any antibiotic prophylaxis in uncomplicated inguinal hernia mesh repairs.

More recently, two studies from the USA have reported on the use of gentamicin/collagen sponges above the fascia at the time of surgical closure in patients undergoing colorectal and cardiac surgery. Counterintuitively, this randomized controlled trial in 602 colorectal patients observed an increase in SSI incidence (30% versus 20.9%, P=0.01) in patients receiving the gentamicin/collagen sponges as compared with the control group. This was explained as possibly being in part due to the mechanical effects of the sponge and the inadequacy of a single local bolus of gentamicin to prevent infection due to Gram-positive cocci, such as S. aureus, compared with the efficacy of large concentrations of gentamicin to treat or prevent Gram-negative bacillary infections. More importantly, these trials have contradicted earlier findings on the efficacy of gentamicin sponges used prophylactically, possibly because these were single-centre studies. For example, one such single-centre, non-blinded study involving 221 patients undergoing colorectal surgery had previously shown a 70% relative reduction in SSI through the use of the sponge (18.4% versus 5.6%, P<0.01).

Many recent publications on the topical use of antibiotics in abdominal surgery focus on morbidly obese patients, as obesity is an independent risk factor for SSI. A recent study of 837 obese patients undergoing laparotomy with 6 weeks of follow-up found that topical kanamycin applied to the subcutaneous space for 2 h led to a significant reduction in SSI in the deep subcutaneous space. A similar study of 400 obese patients undergoing laparotomy in whom topical subcutaneous kanamycin was used significantly reduced SSI. However, both of these studies were observational rather than a comparison between a study group and a control group, and further randomized controlled trials are needed to investigate the potential benefit of topical administration of kanamycin in this selective cohort.

A recent prospective trial examined the use of topical fusidic acid in addition to routine systemic antibiotics applied immediately after surgical closure in patients undergoing emergency Caesarean section. Here, a decrease in SSI was noted from 71.1% to 2.8% (P=0.046) through topical antibiotic use. However, this was a small trial (only 70 patients in total), with a high baseline rate of SSI in control patients.

Overall, in abdominal surgery the evidence would suggest that the application of topical antibiotics should only be considered in morbidly obese patients undergoing laparotomy where the local application of kanamycin has been shown to be of potential benefit. Furthermore, the use of antibiotic-impregnated sponges has been shown to increase wound complication rates in colorectal surgery patients in a well-conducted trial and this intervention should now be seriously questioned.
Orthopaedic surgery

Intravenous administration of surgical prophylaxis is recommended by practice guidelines as an effective measure in SSI prevention. In addition, a recent US study reported that 56% of orthopaedic surgeons used topical antibiotics during intraoperative irrigation to decrease SSI rates. Previous animal studies have suggested that a combination of compounds, including antibiotics, in irrigation fluid during orthopaedic surgery reduces SSI rates. A more recent study assessing the injection of gentamicin solution into surgical wounds in rats resulted in significantly lower levels of bacteria compared with systemic gentamicin treatment. However, subsequent in vitro studies have reported that antibiotic solutions are no more effective in removing staphylococci from stainless steel screws than saline alone. Similarly, neomycin and bacitracin solutions were found to offer no advantage over saline in the removal of bacteria from bone, titanium and stainless steel. In a review, Anglen has commented on the absence of evidence for the efficacy of intraoperative irrigation of antibiotics. A recent prospective randomized controlled trial of 400 patients with and without bacitracin irrigation of open fractures showed no difference in infection rates. Another randomized study of 100 patients undergoing hip surgery assessed the efficacy of topical chloramphenicol applied to the surgical site and found no statistically significant differences in infection rates.

Based on initial animal studies, antibiotic-impregnated cement has been used prophylactically for total joint arthroplasties or as part of treatment when an infected arthroplasty is removed and replaced in a single operation. Gentamicin-impregnated cement has been shown to prevent S. aureus, streptococcal and Gram-negative infections in rat tibias. In addition, erythromycin- and colistin-impregnated cement prevented infection within 7 days of surgery when Escherichia coli was inoculated into joints. Over the last two decades, the use of bone cement impregnated with antibiotic agents has been common practice in joint arthroplasty both in Europe and in the USA. A recent meta-analysis was published examining the effectiveness of antibiotic-impregnated cement as infection prophylaxis. Reporting on 19 studies, a total of 35659 patients undergoing hip replacement were analysed and a significant decrease in SSI rates was noted (2.3% to 1.2%) when antibiotic-impregnated cement was used compared with antibiotic-free cement.

Antibiotic-impregnated beads are also used in orthopaedic surgery prophylactically when repairing open fractures, as well as in the treatment of infected arthroplasties or chronic osteomyelitis. The introduction of local antibiotics in the form of beads fills the dead space and helps to reduce bacterial contamination, thereby preventing infection. A review of 1085 consecutive cases of compound limb fractures undergoing debridement and stabilization demonstrated a significantly decreased rate of infection (from 12% to 3.7%) amongst patients who not only received systemic antibiotics but also had gentamicin-impregnated beads applied locally. A further study compared antibiotic beads with systemic antibiotics in open fractures. The study was randomized and prospective, but found no significant differences between the two prophylactic measures in terms of SSI incidence. However, the study was limited by the small number of patients (67) recruited. Given the lack of adequate randomized controlled trials, recent guidelines from the Surgical Infection Society stated that there was insufficient evidence to support the routine use of antibiotic-impregnated beads as prophylaxis in open fracture surgery.

In summary, considerable evidence exists to support the use of antibiotic-impregnated bone cement as prophylaxis in joint arthroplasty. However, further randomized prospective trials are needed to fully delineate the efficacy of local irrigation with antibiotic solutions of the surgical site or the use of antibiotic beads in the surgical treatment of open fractures.

Cardiothoracic surgery

Systemic prophylaxis is recommended as best practice for SSI prevention in patients undergoing cardiothoracic surgery. In cardiac surgery, post-operative SSI is associated with very significant morbidity and mortality. Previous randomized controlled trials have demonstrated that perioperative intravenous prophylaxis reduces sternal SSI rates by ~80%. However, coagulase-negative staphylococci, which are the most common cause, may be resistant in vitro to the routinely used β-lactam antibiotics. Vancomycin for intravenous prophylaxis is discouraged because of the potential for the emergence of vancomycin-resistant enterococci, the additional cost and because of poor penetration to tissues. Despite this, the intraoperative administration of vancomycin has been shown to be effective in reducing sternal SSI. In a prospective randomized study of 416 patients, the use of topical vancomycin applied to the cut sternotomy edges reduced SSI rates from 3.6% to 0.45% (P=0.02). In addition, in 2005, a larger randomized controlled trial of 2000 patients found that the intraoperative local application of gentamicin/collagen sponges to the sternum resulted in a decrease of SSI incidence from 9% in the control group treated with routine intravenous prophylaxis alone to 4.3% in the group also receiving local prophylaxis (P<0.001). Despite such earlier studies showing a potential benefit, a more recent randomized controlled trial of >1500 patients demonstrated no significant differences in sternal wound infections in patients treated with gentamicin/collagen sponges as well as systemic prophylaxis compared with a control group receiving systemic prophylaxis alone.

Of 504 thoracotomies for lung resection carried out in Greece, local intraoperative instillation of fusidic acid into the pleural space in addition to systemic prophylaxis was used in 290, with the remainder receiving systemic prophylaxis alone. The authors noted a significant decrease in the post-operative rates of SSI, from 6.4% to 1% (P=0.003) in patients receiving instillation of fusidic acid. A further study examining the benefit of local antibiotic prophylaxis in patients undergoing pneumonectomy was carried out in 2001. Here, 93 patients were retrospectively reviewed, with 47 receiving intraoperative intracavitary instillation of an antibiotic solution containing penicillin G, bacitracin and gentamicin. There were statistically fewer cases of empyema in patients receiving the local antibiotics (P=0.012). However, as well as being retrospective, this study also had small numbers and failed to show any difference in overall mortality between the two groups.

Therefore, in patients undergoing sternotomy, controversy exists as to whether application of gentamicin/collagen sponges to the sternum is effective in reducing SSI. In thoracic surgery...
involving lung resection, limited evidence exists to support the use of local antibiotics to prevent SSI. Although small retrospective studies raise the possibility of intrapleural or intracavitary lavage with antibiotic solutions, larger randomized prospective trials are necessary.

**Dermatological surgery**

Currently, patients undergoing simple skin lesion excisions do not routinely receive systemic prophylaxis and it is thought to be reserved for high-risk patients. Chloramphenicol ophthalmic ointment is widely used by plastic surgeons as topical surgical prophylaxis post-operatively: 66% in a recent UK and Ireland survey. The acceptable rate of SSI after clean dermatological surgery should be <5%. A prospective randomized placebo-controlled double-blind trial of 1014 patients carried out in Queensland, Australia, in primary care assessed whether a single post-operative application of topical chloramphenical as surgical prophylaxis reduced SSI rates in minor dermatological surgery. SSI rates were reduced by 4.4% in those treated with topical prophylaxis. Despite the result being statistically significant, the authors considered the results disappointing, having set themselves a target of a 5% reduction. In addition, the SSI rate in the control group was high at 11.1%.

A prospective multicentre study published in 2007 reported no link between the post-operative infection rate in dermatological procedures and surgical prophylaxis. A total of 3491 dermatological procedures were assessed, but no statistically significant differences were noted between the type of surgical prophylaxis used and the SSI rates. However, the primary outcome for this study was an assessment of overall infection control practices in dermatological surgery, rather than a study examining the efficacy of topical antibiotics in these patients.

A recent meta-analysis assessed the value of topical antibiotic prophylaxis in the setting of skin grafting for burns patients. A total of 1113 patients were included in the analysis spanning 40 years (1968–2008). Although the study reported that systemic antibiotics reduced overall mortality, the results were of borderline significance in the actual prevention of SSI. However, this meta-analysis also reported no statistical advantage through the application of topical antibiotics.

In summary, controversy exists as to whether topical antibiotic prophylaxis is of benefit in patients undergoing clean dermatological surgery. In patients undergoing skin grafting for burns, topical antibiotics are not indicated.

**Breast surgery**

The CDC recommend a first-generation cephalosporin for systemic perioperative prophylaxis only in breast surgery involving implants. The frequency of SSI following aesthetic breast augmentation is 1.1%–2.5%. In patients undergoing breast augmentation procedures, the topical delivery of cefazolin through intraoperative irrigation results in equivalent concentrations in the wound comparable to intravenous delivery. However, this study consisted of only 24 patients, with the primary outcome measured being serum and wound drainage antibiotic concentrations rather than SSI rates.

A recent retrospective study of 436 patients assessed the effectiveness of adding cefalotin to the irrigation of the breast implant pocket versus normal saline alone and found that SSI rates were significantly reduced from 12.8% to 6.7% in those in whom a topical antibiotic was used. However, this was a retrospective study and, consequently, the impact of topical cefalotin may have been overestimated.

Overall, further randomized controlled trials are required to fully investigate whether the topical application of surgical prophylaxis is effective in the prevention of SSI in certain categories of breast surgery.

**Ocular surgery**

Endophthalmitis is a devastating complication that may follow intraocular surgery. Although various measures have been suggested to reduce the risk of post-operative bacterial endophthalmitis, current guidelines recommend pre-operative conjunctival irrigation with 5% povidone iodine as prophylaxis against infection. In addition, the Endophthalmitis Study Group of the European Society of Cataract and Refractive Surgeons reported reductions in post-operative endophthalmitis incidence following cataract surgery in patients receiving intracameral cefuroxime injection in addition to povidone iodine. The penetration of systemically administered antibiotics into the eye is uniquely restricted by the presence of blood–ocular barriers: the blood–aqueous barrier and the blood–retina barrier. Achieving therapeutic drug levels, particularly with hydrophilic antibiotics, such as aminoglycosides, β-lactams and glycopeptides, may be difficult. Other forms of drug administration, such as topical or intra-vitreal, may be used in an attempt to overcome these issues.

Concentrations of vancomycin in the irrigating solution used in cataract surgery have been shown to be adequate for bacterial inhibition in the anterior chamber of the eye at the end of cataract surgery. Furthermore, a study in 2001 demonstrated a decreased rate of positive bacterial cultures in patients who had vancomycin (20 mg/L) in the intraoperative irrigating fluid compared with those patients who did not receive local vancomycin. The efficacy of topical antibiotics has also been shown in clinical settings. Intracameral (i.e. administration into the anterior chamber of the eye) injection of cefazolin as surgical prophylaxis at the end of cataract surgery has been shown to reduce the rate of post-operative endophthalmitis. In 2002, a retrospective observational study observed a post-operative infection rate of only 0.06% following post-cataract surgery administration of intracameral cefuroxime in a single-centre study. However, this study did not describe a before-and-after analysis of the use of intracameral cefuroxime; rather, it described low rates of infection with its use. A further retrospective observational study of >7000 patients noted a significantly reduced rate of post-operative endophthalmitis in cases who received intracameral cefazolin at the end of surgery (0.055%) compared with those who did not (0.63%). Similarly, prophylactic subconjunctival antimicrobial prophylaxis administered post-operatively decreased the incidence of endophthalmitis as the antibiotic concentrations in the anterior chamber were shown to inhibit/kill intraoperative bacteria. One such study demonstrated a decrease in post-operative endophthalmitis from 0.179% to 0.011%. Although this study was a retrospective chart review, it included 13886 consecutive cataract operations.

In summary, given the difficulty in achieving effective antibiotic levels at the surgical site in ophthalmological surgery,
intracameral or subconjunctival administration of surgical prophylaxis has been reported as being effective in the prevention of SSI. Although retrospective, these studies consist of large numbers of patients demonstrating statistically significant results, making the possibility of future blinded prospective randomized trials less likely and less compelling.

**Discussion**

Compared with systemic antibiotic prophylaxis, the topical application of antimicrobial agents has many potential advantages, including limiting the possibility of systemic toxicity and allowing for high concentrations of antimicrobials at the surgical site. Furthermore, the avoidance of systemic antibiotics reduces the potential development of antibiotic resistance. However, there are also a number of disadvantages, including interference with the surgical site healing process, local hypersensitivity or contact dermatitis reactions and difficulties in accurately determining the dose, as the rigorous trials to determine this are not available, unlike with the use of antibiotics for systemic use. In addition, concern remains about the overuse of topical antibiotics resulting in antibiotic resistance. Previous guidelines suggest that use of topical antibiotics should be restricted, because of the capacity of most topical drugs to select resistant microorganisms and to cause sensitization.

Surveys have shown high levels of topical antibiotic use for prophylaxis and some surgical procedures have been shown to significantly benefit from perioperative topical prophylaxis (Table 1). This is evident in joint arthroplasty, where the use of antibiotic-impregnated cement has been shown to be effective in SSI prevention. Further examples include ocular surgery, where the perioperative intracameral or subconjunctival administration of antibiotics has been shown to decrease postoperative rates of endophthalmitis in trials, which, although retrospective, consist of large cohorts of patients with statistically and clinically significant results.

**Table 1.** Comparative studies showing a statistically significant reduction in SSI rates through prophylactic use of topical of local antibiotics

<table>
<thead>
<tr>
<th>Surgical specialty</th>
<th>Operation</th>
<th>Study type</th>
<th>Intervention</th>
<th>Significant finding</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abdominal surgery</td>
<td>colorectal</td>
<td>randomized controlled trial of 221 patients</td>
<td>gentamicin/collagen sponge</td>
<td>reduction from 18.4% to 5.6%</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>emergency Caesarean section</td>
<td>non-randomized prospective study of 70 patients</td>
<td>fusidic acid</td>
<td>reduction from 17.1% to 2.8%</td>
<td>32</td>
</tr>
<tr>
<td>Orthopaedic surgery</td>
<td>hip arthroplasty</td>
<td>meta-analysis of 35695 patients</td>
<td>antibiotic-impregnated bone cement</td>
<td>reduction from 2.3% to 1.2%</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>debridement and stabilization of compound limb fractures</td>
<td>retrospective observational study of 1085 patients</td>
<td>gentamicin-impregnated beads</td>
<td>reduction from 12% to 3.7%</td>
<td>47</td>
</tr>
<tr>
<td>Cardiotoracic surgery</td>
<td>patients undergoing sternotomy</td>
<td>randomized controlled trial of 416 patients</td>
<td>vancomycin</td>
<td>reduction from 3.6% to 0.45%</td>
<td>61</td>
</tr>
<tr>
<td></td>
<td>patients undergoing lung resection</td>
<td>randomized controlled trial of 2000 patients</td>
<td>gentamicin/collagen sponges</td>
<td>reduction from 9% to 4.3%</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td></td>
<td>retrospective observational study of 504 thoracotomies</td>
<td>irrigation of the pleural space with fusidic acid</td>
<td>reduction in empyema from 6.4% to 1%</td>
<td>62</td>
</tr>
<tr>
<td></td>
<td></td>
<td>retrospective observational study of 93 thoracotomies</td>
<td>intracavitary irrigation with penicillin, gentamicin and bacitracin</td>
<td>reduction in empyema from 13% to 0%</td>
<td>63</td>
</tr>
<tr>
<td>Dermatological surgery</td>
<td>patients undergoing clean skin lesion excision</td>
<td>randomized controlled trial of 1014 patients</td>
<td>chloramphenicol ointment applied to the surgical site</td>
<td>reduction from 11% to 6.6%</td>
<td>69</td>
</tr>
<tr>
<td>Breast surgery</td>
<td>patients undergoing breast augmentation</td>
<td>retrospective observational study of 436 patients</td>
<td>irrigation of the implant pocket with cefalotin solution</td>
<td>reduction from 12.8% to 6.7%</td>
<td>76</td>
</tr>
<tr>
<td>Ocular surgery</td>
<td>post-cataract surgery</td>
<td>retrospective observational study of 7260 patients</td>
<td>intracameral cefazolin administration of differing subconjunctival antibiotics</td>
<td>reduction in endophthalmitis from 0.63% to 0.055%</td>
<td>85</td>
</tr>
<tr>
<td></td>
<td></td>
<td>retrospective observational study of 13886 cases</td>
<td></td>
<td>reduction in endophthalmitis from 0.179% to 0.011%</td>
<td>86</td>
</tr>
</tbody>
</table>
Randomized controlled trials in cardiac surgery patients after sternotomy have demonstrated a decrease in SSI of up to 80% through the local application of both vancomycin and gentamicin to the cut sternotomy wound edges. However, given the reluctance to widely use vancomycin because of fears of vancomycin resistance developing, there remains the potential of local application of gentamicin/collagen sponges as standard prophylaxis in SSI prevention. However, previous randomized trials noting a decreased SSI rate through their use have not been confirmed by a recent multicentre trial.

In patients undergoing abdominal surgery, there is limited evidence to support the routine use of topical antibiotics as prophylaxis. Older studies examining the efficacy of the local application of antibiotics as prophylaxis in gallbladder surgery failed to demonstrate a clinical benefit. Similarly, a more recent study in patients undergoing inguinal hernia mesh repair also failed to demonstrate an advantage conferred by topical antimicrobials. Worryingly, a randomized controlled trial from 2010 has demonstrated an increased SSI incidence in colorectal surgery patients receiving local application of gentamicin/collagen sponges. Despite this, topical intraoperative antibiotics to minimize SSI may be indicated in morbidly obese patients. When we consider that in 2030 it is expected that >85% of adults will be obese, it is clear that the role of topical antibiotics in surgical prophylaxis may increase if these findings are confirmed by prospective randomized studies.

This review highlights a number of areas wherein the widespread use of topical antibiotics is not supported by sufficient evidence. For example, despite the lack of prospective clinical data demonstrating the effectiveness of intraoperative irrigation with antibiotics, the majority of those performing orthopaedic surgery continue its use. Similarly, antibiotic-impregnated beads continue to be widely used in open fracture surgery, despite a need for blinded prospective randomized trials to justify their use. In addition, breast augmentation involving implants has been shown to have a reduced SSI rate when topical antibiotics are used. A similar trend is also noted in a retrospective study of patients undergoing Caesarean section, but prospective studies are required to fully determine whether local antibiotics are of benefit in this patient cohort. The topical administration of antibiotic prophylaxis to the surgical site is common amongst plastic surgeons, but its effectiveness is not borne out in clinical studies; notwithstanding a recent large trial demonstrating a reduction in SSI rates after dermatological surgery. However, given the low rates of SSI in clean dermatological procedures, it is evident that trials with larger numbers will be necessary to ascertain whether topical prophylaxis would be truly effective.

Any adjunct to surgery that can reduce SSI is welcome and interventions aside from antibiotic use have also been investigated previously. A recent Cochrane review regarding surgical hand antisepsis has suggested that chlorhexidine gluconate-based aqueous scrubs are more effective than povidone iodine-based aqueous scrubs in terms of the numbers of colony forming units on surgeons hands. Hair removal from the surgical site pre-operatively has also been investigated, with no differences in SSI rates reported among patients who have had hair removed prior to surgery and those who have not. Similarly, a further Cochrane review has also shown that the use of chlorhexidine bathing or showering pre-operatively is ineffective in SSI prevention.

Surgical practices are based on a combination of knowledge gained during training and the evidence. The use of antibiotics in the prevention of SSI is widespread with good evidence reporting the benefits of systemic prophylaxis. However, in many cases, topical antibiotic use is based on behaviour and ritual, rather than familiarity with the published evidence. As previously outlined, evidence does exist to support the use of topical antibiotics in orthopaedic and eye surgery. However, as we have demonstrated, the use of topical antibiotics as prophylaxis in a number of surgical procedures is not evidence-based. This is important in light of the increasing problem of bacterial resistance to antibiotics; topical antibiotics as prophylaxis should only be routinely administered where there is a clear evidence base to support their use.

Conclusions

The selective use of topical antibiotics as surgical prophylaxis is justified for specific procedures, such as joint arthroplasty, cataract surgery and, possibly, breast augmentation. In obese patients undergoing abdominal surgery, topical surgical prophylaxis is also proven to be potentially beneficial. This is likely to be of increased importance in the future, given the increasing obesity rates in Western populations. The local intraoperative administration of antibiotic prophylaxis commonly performed in other orthopaedic procedures, plastic/dermatological surgery and abdominal surgical procedures in non-obese patients remains underevaluated and, to date, unproven. Topical antibiotics as surgical prophylaxis can only be recommended where there are prospective randomized trials demonstrating clear efficacy.

Transparency declarations

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Review


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