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REVIEW ARTICLE

ANTIBIOTIC PROPHYLAXIS FOR PREVENTION OF POSTOPERATIVE INFECTIONS FOLLOWING IMPACTED TOOTH REMOVAL: A COMPREHENSIVE REVIEW

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Abstract
Numerous controversies exist about the use of antibiotics for third molar extraction which stands as a prevalent oral surgical intervention. The review analyzes present data about antibiotic preventative measures following procedures involving impacted teeth extraction. Randomized trials combined with systematic reviews support that providing antibiotics before treatment reduces infection possibilities between 34% and 66%. Patients require antibiotic prophylaxis when their surgery involves deep impactions and belongs to older age groups with lengthy procedures including complex surgeries. Amoxicillin along with its combination form amoxicillin/clavulanic acid continue to be the preferred antibiotic medications but they present unique advantages and disadvantages. No research-based findings indicate that healthy patients need prophylactic medications before having uncomplicated extractions. Medical practitioners should maintain a balance between protecting patients from infection while managing antibiotic usage and evaluate individual patient characteristics for determining appropriate preventive therapies.

Keywords: Antibiotic prophylaxis; Third molar extraction; Impacted tooth; Surgical site infection; Dry socket; Postoperative complications

INTRODUCTION

The removal of third molars stands as one of the most common procedures within oral and maxillofacial surgery since healthcare providers perform millions of such operations yearly throughout the world[1]. The procedure has become common but patients face substantial dangers from postoperative consequences which include abscess, dry socket and infection alongside discomfort and swelling and limited mouth opening [2]. Surgical site infections after third molar surgery are reported to affect 0.4% to 6% of patients while dry socket develops in 1% to 30% of patients according to medical studies [3, 4].

Professional practitioners commonly prescribe prophylactic antibiotics because of these possible complications. The practice remains controversial among professionals because there exists no agreement regarding prophylactic antibiotic usage for third molar extractions[5]. The disagreement about antibiotic prescriptions during third molar extractions exists due to research contradictions alongside antibiotic resistance concerns alongside adverse effects and cost efficiency considerations [6].

According to Peterson the main requirements for antibiotic prophylaxis include selecting surgical procedures with high infection risk and choosing appropriate antibiotics and proper dosage levels and correct timing and using minimal effective treatment duration [7]. The choice to provide antibiotics before third molar extractions remains contested among professionals when treating healthy patients.

Research trying to establish antibiotic prophylaxis effectiveness in third molar surgery produced inconclusive results due to methodological issues and outcome definition heterogeneity in primary studies [8,9]. The Cochrane review noted that antibiotic use could help prevent infections yet suggested that benefits from this practice might not justify such risks because 19 patients require treatment to stop one infection based on the available evidence [4].

The present study reviews recent evidence about antibiotic prophylaxis for surgical site infections after impacted tooth surgery while exploring risk factors for treatment and analyzing different antibiotic protocols

with clinical practice recommendations.

2. Types of Postoperative Infections Following Third Molar Extraction

2.1 Surgical Site Infection

The most common signs of Surgical site infections (SSIs) after third molar extraction include pain alongside swelling, purulent discharge, abscess development and cellulitis[9]. Data shows that SSIs occur between 0.4% and 6% of patients although bone removal procedures show higher incidence [3,9].

The temporal onset of surgical site infections divides them into normal and delayed types where early-onset forms occur during the first seven days and delayed-onset develops between 2 to 8 weeks postoperatively[10]. Early bacterial contamination through surgical procedures leads to early-onset infections whereas delayed-onset infections emerge from bacterial persistence which affects either the socket or surrounding tissue areas mainly affecting patients with restricted distal space[10].

The majority of postoperative infections develop from regular oral microorganisms which include both aerobic and anaerobic bacteria. The main pathogens responsible for postoperative infections comprise streptococci, staphylococci and bacteroides and fusobacterium which belong to gram-negative bacilli [8].

2.2 Dry Socket (Alveolar Osteitis)

Dry socket develops as alveolar osteitis which produces intense pain alongside total blood clot destruction in the extraction site during the postoperative day 1-3 period [4]. Dry socket serves as localized osteomyelitis but stands outside the true infection category because researchers include it in antibiotic prophylaxis studies [11].

Recent research about dry socket incidence after third molar extractions presents conflicting information that ranges between 1% and 30%[12]. The list of known risk elements consists of smoking combined with oral contraceptive use yet also contains poor oral hygiene practice alongside traumatic extractions and difficult impactions [12].

2.3 Other Infectious Complications

Other less common infectious complications include osteomyelitis, fascial space infections, and rarely, life-threatening infections such as Ludwig's angina or cavernous sinus thrombosis [3]. These severe complications are more likely to occur in immunocompromised patients or when infections are inadequately treated [3].

3. Risk Factors for Postoperative Infections

3.1 Patient-Related Factors

Multiple characteristics which belong to patients have been identified as risk factors for developing postoperative infections. Recent research proves that patients beyond the age of 35 tend to develop more infections at higher frequencies[13]. Research data showed that patients above 36 years of age developed more postoperative infections compared to their adult counterparts[13].

The risk of microbial infections elevates when patients present with diabetes mellitus alongside HIV/AIDS and when they use immunosuppressive drugs and experience malnutrition complications [3]. Most antibiotic prophylaxis clinical trials decided against including medically needy patients even though there exists insufficient research about appropriate preventive measures for such vulnerable groups [4].

Patient-based factors that increase susceptibility to infection include smoking combined with inadequate oral hygiene and hormonal states during pregnancy and oral contraceptive use [12].

3.2 Anatomical Factors

Anatomical characteristics of the impacted tooth significantly influence infection risk. The depth of impaction, as classified by Pell and Gregory or Winter's classification, correlates with postoperative infection rates [9,13]. Fully impacted teeth requiring significant bone removal present higher risks compared to partially erupted teeth [14].

Tooth angulation also affects infection risk, with mesioangular and horizontal impactions generally requiring more extensive surgical manipulation and thus carrying higher infection risks [9].

3.3 Surgical Factors

The length of surgical procedures strongly determines the risk of infections developing. Postoperative infections grow in direct proportion to surgical time which serves as a reliable predictor for infection development[13]. The length of surgical procedures leads to increased tissue handling and bacterial contamination together with surgical complexity which results in higher infection rates.

Various studies [9,13] have confirmed that intraoperative hemostatic procedures present substantial risks for developing postoperative infections.

The infection risk during surgery depends on the procedures which the surgeon performs especially regarding flap designs and bone removal procedures as well as techniques used for wound closure [14]. The educational attainment of surgeons proved to be connected to infection rate ($p=0.021$, odds ratio=0.14) thus demonstrating that surgical proficiency directly affects surgical outcome [14].

4. Antibiotic Prophylaxis: Current Practices

4.1 Types of Antibiotics Used

The prophylaxis treatment of third molar surgery requires evaluation of multiple antibiotics while penicillins remain the standard choice for practice. Medical professionals prescribe amoxicillin alone or in combination with clavulanic acid as the primary antibiotic due to its wide antipathogenic properties and desirable drug properties

and acceptable safety profile [15].

Patients who are allergic to penicillin can receive their prophylaxis from three medications: clindamycin, azithromycin and metronidazole [7,8]. These anti-infectives show unique attributes that affect their use as well as drawbacks in different applications. Research has demonstrated that Clindamycin effectively treats oral infection anaerobes through proven concentrations of 150mg, 300mg, and 600mg [7]. Single-dose treatment with extended tissue distribution becomes possible because azithromycin has a half-life span of 8 days [8].

4.2 Timing and Duration

Provisional timing of antibiotic administration determines the success rate of prophylactic measures. Doctors typically advise patients to take antibiotics within one hour prior to surgery for adequate tissue presence during the medical operation [11]. Antibiotic levels need to remain high during the period of possible bacterial contamination according to Peterson's principle [7].

Medical research studies together with clinical practice employ numerous time periods for antibiotic prophylaxis administration. True prophylaxis consists of one preoperative dose only yet multiple medical practitioners provide antibiotic coverage lasting between 3 to 7 days after surgery [1,6]. Medical experts describe these longer antibiotic treatments as empiric therapy since they avoid the definition of true prophylaxis [3].

Medical evidence indicates that preoperative antibiotics administered at a single dose produce similar results to longer administration periods. The administration of a single 500 mg dose of azithromycin conducted better than using multi-day regimens since it led to a 2% (8) infection rate after surgery. No clear evidence shows that prolonged antibiotic usage beyond 3 days offers benefits to patients yet extends the risks of side effects and antibiotic resistance [15].

4.3 Administration Routes

Systemic antibiotics applied as oral plans or intravenous treatments remain the main method for surgical site prevention [1]. The two approaches work toward reaching adequate antibiotic distribution throughout surgical site blood and tissues.Researchers have studied topical antibiotics because they could be suitable alternatives or joint treatments alongside systemic prophylaxis.

The application of tetracycline ointment on the tongue's dorsum once every six hours after surgery for two days resulted in lower oral cancer surgery site infections than control treatments (19.6% vs. 36.1%) [2]. Research about prophylaxis for third molar extractions remains scarce.

5. Evidence for Efficacy of Antibiotic Prophylaxis

5.1 Effect on Surgical Site Infection

Research studies held contradictory findings about antibiotic preventive measures for reducing SSIs in third molar extractions. Medical evidence points to antibiotics as effective in reducing postoperative infectious complications by a rate of 66% (Risk Ratio 0.34, 95% CI 0.19 to 0.64) which needs 19 patients treated [4]. The data indicates that twenty-two patients will require antibiotic treatment for preventing one infection.

Controlled trials generate inconsistent results because of differences that occur between patient groups as well as surgical methods and infection diagnosis criteria. Directed studies employing clear admission standards and standardized surgical procedures identify reduced overall infection numbers and produce minimal treatment-control group divergence [5,11].

5.2 Effect on Dry Socket

Research about antibiotic prophylaxis as a dry socket prevention method remains uncertain. Research shows antibiotics decrease dry socket occurrence by 34% (risk ratio 0.66, 95% CI 0.45 to 0.97) but treatment for 46 [4] patients results in this outcome.

The administration of antibiotics proved effective in reducing the occurrence of dry socket along with surgical site infections for people who underwent lower third molar extraction procedures [12]. The evidence about antibiotic prophylaxis as a dry socket prevention method is uncertain because studies reveal conflicting results regarding its effectiveness [15].

5.3 Comparative Efficacy of Different Antibiotics

Both amoxicillin (1g) and amoxicillin/clavulanate (875/125mg) were equally effective in preventing infection after third molar extraction, but amoxicillin/clavulanate produced significantly more gastrointestinal discomfort [6]. This highlights the need to balance efficacy with potential adverse effects.Studies of alternative antibiotics for penicillin-allergic patients have shown promising results.

6. Potential Adverse Effects and Concerns

6.1 Antibiotic Resistance

Broad-scale antibiotic prophylaxis causes the most important side effect which is antibiotic resistance development. The inappropriate and excessive prescription of antibiotics leads to resistant bacterial strain formation thus becoming a crucial worldwide health concern [16]. The various microorganisms that exist in the oral cavity function as a resistance gene reservoir [16].

Medical professionals should evaluate the possibility of resistance development against the protective advantages of minimizing non-fatal post-extraction infections in healthy patients with third molars [15]. Society needs to perform detailed risk-benefit evaluations since third molar extractions occur frequently throughout the world.

6.2 Adverse Reactions

The use of antibiotics entails known potential complications considered as mild gastrointestinal side effects through severe allergic reactions. The combination of amoxicillin/clavulanic acid leads to increased gastrointestinal problems than amoxicillin usage alone [6].

People can experience different severity levels of allergic reactions to antibiotics but beta-lactam antibiotics present the most risk for severe anaphylaxis. Routine prophylaxis for third molar extractions poses risk to a small number of patients who are prone to severe allergic reactions (0.01-0.05% for penicillins), a factor that should be considered given the large number of procedures [16].

Patient exposure to antibiotics leads to two main unwanted effects: normal gut microbiota disruption which causes antibiotic-associated diarrhea or Clostridioides difficile infection along with the possibility of serious conditions such as Stevens-Johnson syndrome or toxic epidermal necrolysis occurring rarely [17-20].

6.3 Cost-Benefit Considerations

The financial assessment of antibiotic prophylaxis needs to correlate with medical advantages. Both direct costs arise from antibiotic acquisition but indirect costs include antibiotic side effect management as well as antibiotic resistance development and healthcare resource utilization [11].

Prophylactic antibiotic use for preventing infections or dry sockets after third molar removal demonstrates a demanding number needed to treat 19-46 people to stop a single case thereby making routine prophylaxis less economical for all extractons [4]. The practice of giving antibiotic prophylaxis to specific patients at high risk delivers an optimal balance between medical benefits and financial costs.

7. Recommendations for Clinical Practice

7.1 General Recommendations

Research shows that medical professionals should avoid giving antibiotics as a standard practice for third molar extractions since the majority of simple procedures in healthy patients do not require them [3, 4, 15]. Research shows a low rate of serious infections as an insufficient justification for exposing patients to antibiotic risks [15].

The decision to provide antibiotics before surgical extractions depends on individual procedural requirements [3]. The assessment process needs to base its decision on personal risk evaluation which combines patient-linked features with procedure specific elements [13].

The clinical evidence indicates that healthy patients require a single dose of antibiotics before surgery to achieve optimal prophylaxis [8]. Special high-risk scenarios warrant the use of extended postoperative antibiotic treatments according to the guidelines [3].

7.2 High-Risk Patients

People who have diminished immune function or systemic diseases that impair wound healing or prior surgical site infections usually qualify for antibiotic prophylaxis [3,4]. The healthcare provider should consider antibiotic preventive treatment for patients who have diabetes mellitus, immunosuppressive health conditions, or take immunomodulatory medications [3].The prevention measure is appropriate for patients whose oral structure has specific anatomical risk factors consisting of deeply situated teeth that need extensive bone destruction or teeth with small available distal space [10].

7.3 Alternative Approaches

Additional infection prevention strategies consist of preoperative oral disinfection and precise surgical practices as well as proper wound care and adequate postoperative instructions [1,2].

Multiple studies indicate chlorhexidine mouth rinses provide effective postoperative results by decreasing complications so they function well as an antibiotic substitute method [1]. Evidence about the effectiveness of topical antibiotics used on surgical sites for third molar extractions remains scarce according to studies [2].

8.CONCLUSION

Prevalent use of antibiotics during third molar extractions needs thorough evaluation of patient-specific risk elements together with both positive treatment consequences and adverse drug responses. Research fails to demonstrate that all patients need antibiotic medications before third molar extraction unless they have medical complications or complicated extraction procedures.

Specific patient groups who need antibiotics as prevention can benefit from prophylactic medicine when receiving bone-intensive extractions or when experiencing older age or extended surgical process or weakened immune system. The indication of antibiotic prophylaxis requires just a single preoperative administration of the appropriate medication for prevention purposes.

Given worries about antibiotic resistance, appropriate antibiotic prescriptions in dental practice become essential. The medical professionals need to evaluate the minimal decrease in infection risks versus the extensive dangers posed by antibiotic misuse in public health frameworks. Future investigations should concentrate on developing exact risk assessment methodologies for improving patient selection in prophylaxis and performing targeted prophylaxis evaluations versus standard protocols and exploring antibiotic-independent prevention strategies for surgical complications.

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