

Evaluating Antibiotic Prophylaxis in Breast Cancer Surgery
An Experience of Post-COVID Era

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Abstract	
Author Details	Background: The role of prophylactic antibiotics in reducing surgical site infections (SSI) and improving wound healing after breast cancer surgery remains debated. This study assessed the effectiveness of a single preoperative dose of amoxicillin–clavulanic acid on postoperative infection rates and wound outcomes. Objective: To evaluate the impact of prophylactic antibiotics on the frequency of surgical site infections in breast cancer surgery. Methods: A quasiexperimental study was conducted on 180 patients undergoing breast cancer surgery at Khyber Teaching Hospital, Peshawar. Demographic variables, BMI, ASA classification, comorbidities, tumor receptor status, type of surgery, antibiotic use, COVID-19 infection history, and vaccination status were recorded. Postoperative wound outcomes were assessed on Day 7 and Day 14. Statistical associations were analyzed using chi-square tests, with $p<0.05$ considered significant. Results: The mean age was 48.2 ± 10.15 years, and mean BMI was 21.9 ± 1.88 . Most
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patients were ASA I (55%) or ASA II (40%). Comorbidities were present in 45.8%, predominantly hypertension and diabetes. Antibiotic use showed significant associations with age, BMI, type of surgery, ER/PR/HER2 status, and comorbidities ($p < 0.001$). Patients receiving prophylactic antibiotics had significantly fewer postoperative complications at Day 7 and Day 14 ($p < 0.001$). COVID-19 positivity was also significantly associated with higher infection rates ($p < 0.001$). Conclusion: Prophylactic antibiotic use was associated with reduced postoperative complications and SSI in breast cancer surgery. However, concerns regarding antimicrobial resistance highlight the need for judicious antibiotic use and further research into patient-specific prophylactic strategies.

Keywords: Prophylactic antibiotics, Surgical Site Infection (SSI), breast cancer surgery, COVID-19, randomized allocation, quasi-experimental study.

Introduction

Breast cancer has been one of the most prevalent malignancies in all the areas of the world with over 2.3 million cases being diagnosed each year [1]. One of the treatment pillars is a surgical intervention, and the postoperative complications, in particular, surgical site infections (SSI) are likely to slow down the recovery process and increase the cost of healthcare. SSIs have a high occurrence rate in the entire world with reported rates of 2-20 per cent depending on the type of surgery and the population of patients [2].

Prophylaxis with the use of antibiotics has been employed as a way of decreasing the risk of SSIs. Their practicality, optimal time and necessity is however, a controversial point. There is a single research that thinks that a single dose of antibiotics before the surgery would be more effective in reducing the infection rate [3], although other studies doubt the cost-effectiveness of the method and antibiotic resistance [4]. The COVID-19 pandemic presented new challenges in the operations of the globe. It has been demonstrated that long-term immune dysregulation has occurred in patients who have already been cured of severe acute respiratory syndrome coronavirus 2 (SARSCoV-2) infections and can put them into a risk of higher risks of getting infected in the process of surgery [5]. Additionally, the mass usage of COVID-19 vaccines put under question their potential immunomodulatory effect and the possibility of their influence on the rates of SSI [6].

The extensive recommendation is to receive antibiotic prophylaxis by means of clean-contaminated surgery (mastectomies and lymph node dissections) [7]. Amoxicillin-clavulanic acid is a beta-lactam antibiotic of the group (the most typical ones are

amoxicillin and clavulanic acid), however, with the action of a broad-spectrum antibiotic [8]. Despite its popularity, there have been concerns over the unnecessary use of antibiotics that caused antimicrobial resistance that is a rising public health crisis of challenge with estimated 1.27 million deaths per year [9]. The COVID-19 pandemic has had an impact on the healthcare systems of all countries in the world and led to the inability to diagnose and treat cancer [10]. It is even emerging that patients who developed severe COVID-19 infection, might experience the continuation of systemic inflammation and immune dysfunction, which can predispose them to SSIs [11]. In addition, the rapid pace of mRNA-based vaccines introductions has generated some doubts about the long-term effect of vaccination on immune-response, but the recent findings do not prove the existence of any severe reactions on the outcome of surgical operations [12].

Methodology

Results and Analysis

Table 1: DemographicandClinicalCharacteristics

Characteristic	Statistics
Age Range	20-69 years

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Mean Age	48.2 years	The current quasi experimental research was to investigate the efficacy of prophylactic
Median Age	43.01 years	
Standard Deviation	±10.15	
BMI Range	18.2-25.7	
Mean BMI	21.9	

antibiotics in reducing the count of postoperative wounds infection on breast cancer surgery patients, at the Breast Surgery Department of Khyber Teaching Hospital, Peshawar, under the permission of the Institutional Research Ethics Board (IREB). The research involved randomized allocation performance, whereby 180 patients with Stage 1-3 breast cancer were divided into two groups with rigid inclusion and exclusion criteria, in which those patients who had to undergo a surgery due to Stage 1-3 breast cancer were included in the research whereas those with ulcers on the tumor or those who had a history of undergoing biopsy in the recent past were excluded with the special consideration given to those patients who had undergone neoadjuvant chemotherapy and were operated more than three weeks before the research and were confirmed to be immune using full blood count Day 3, Day 7 monitoring parameters, redness, pus discharge, and wound

disruption were evaluated and the infected wound culture samples were taken with the measurement of the demographic and clinical data being measured with the help of a structured proforma and statistical analysis being done with the help of SPSS.

Characteristic	Statistics
Median BMI	22.50
BMI Standard Deviation	±1.88

Table 1 shows the demographic data shows a wide age distribution with most patients in their Middle Ages. BMI distribution indicates that the majority of patients were within the normal weight range.

Table 2: ASAClassificationDistribution

	Percentage
ASA Class	
ASA 1 (Healthy)	55%
ASA 2 (Mild Disease)	40%

ASA 3 (High Risk)	1.1%
ASA 4 (High Risk)	1.1%

Table 2 shows the ASA classification reveals that most patients were either healthy or had mild systemic disease, with only a small percentage classified as high-risk. Table 3: COVID-19andVaccinationStatus

Category	Percentage
No COVID History	79.2%
Vaccinated	82.8%
Unvaccinated	10.9%

Table 3 shows the data shows high vaccination coverage among the study population, with most patients having no prior COVID-19 infection history.

Table 4: ComorbidityDistribution

Comorbidity	Percentage
Total with Comorbidities	45.8%
Hypertension	19.8%
Diabetes	18.8%

Table 4 shows that half of the study population presented with comorbidities, with hypertension and diabetes being the most prevalent conditions.

Table 5: ResultsforFactorsAssociatedwithAntibioticUse

Factor	ChiSquare Value (X ²)	Degrees of Freedom (df)	Asymptotic Significance (p-value)	Key Observations
BMI	108.892	45	0	Statistically significant association. Higher BMI correlates with increased antibiotic usage, though low expected counts reduce reliability.

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Age	78.84	34	0	Significant association. Older age groups (55 and above) are more likely to receive antibiotics. Low expected counts limit precision.
Mode of Surgery	212.663	6	0	Strong relationship. Specific surgeries (e.g., NAC) show higher antibiotic usage. Expected count issues, but robust findings.
ER	194.294	4	0	Significant association. ER-positive patients are more likely to receive antibiotics. Low expected counts in some cells.
PR	193.444	4	0	Statistically significant association. PR-negative patients are more likely to receive antibiotics. Low expected counts in some cells.
Her2	165.875	6	0	Significant association. Her2negative patients tend to receive antibiotics more frequently. Concerns about low expected counts.
Co-Morbidities	198.253	8	0	Significant association. Patients with co-morbidities (e.g., diabetes, hypertension) are more likely to receive antibiotics.

Table 5 highlights the statistically significant associations between various patient factors and antibiotic use. For instance, BMI shows a strong correlation with antibiotic usage, suggesting that obese patients may require more antibiotics due to their higher risk of infections. However, the low expected counts in some categories reduce the reliability of these findings. Similarly, older age groups and specific surgeries exhibit higher antibiotic usage, reflecting the increased vulnerability of these populations to postoperative infections.

Table 6: ResultsforPostoperativeOutcomesandAntibioticUse

Association		ChiSquare (χ^2)	p-value	Findings
COVID Infection	and	192.099	<0.001	Significant association between Covid and infection: Covid positivity is linked to higher infection rates. The extremely low p-value suggests strong evidence.
Postoperative Complications (Day 7)	&	205.324	<0.001	Significant. Fewer complications in antibiotic group (n=81). Minor complications: pus discharge (n=14), dehiscence (n=2).
Postoperative Complications (Day 14)	&	217.833	<0.001	Significant. Fewer complications in antibiotic group (n=75). Mild complications: pus discharge (n=19), dehiscence (n=4).
Culture Sensitivity Results & Preoperative Antibiotics	&	18.78	0.043	Significant. More "no growth" in antibiotic group (n=10). Resistant bacteria: Pseudomonas (n=9), Citrobacter (n=2).
COVID-19 Infection	&	192.104	<0.001	Significant. 16 COVID-positive patients in antibiotic group vs. 12 in non-antibiotic group. No direct antibiotic effect on viral infection.
Vaccination Status	&	193.373	<0.001	Significant. More vaccinated individuals received antibiotics (n=89), possibly due to
Preoperative Antibiotic Use				

Table 6 focuses on the outcomes associated with antibiotic use. A significant association is observed between COVID-19 positivity and infection rates, indicating that COVIDpositive patients are at a higher risk of developing infections. Additionally, the data shows that patients receiving antibiotics experience fewer postoperative complications, both at Day 7 and Day 14, suggesting that prophylactic antibiotics may play a protective role in surgical settings.

Discussion

The results of the study are supported by recent literature on the use of prophylactic antibiotics in surgery of the breast cancer. [13] reported the same findings in their metaanalysis of 2,500 cases and found a 45 per cent reduction in the incidence of a surgical site infection when prophylactic antibiotics were used. The correlation between the COVID-19 vaccine and infection rate is consistent with the results [14], who showed increased post-surgery recovery in patients who were vaccinated.

In some instances, there are some of the antibiotic-resistant bacteria, which resonate the worries of the appearance of resistant strains in the surgical context [15]. The results of our research on BMI and risk of infection are consistent with [16], who found that higher BMI was one of the risk factors of surgical site infections. Research studies have revealed that responsible is obesity which predisposes surgical site infections (SSIs) because of disrupted wound healing and malfunctioning immune system [17]. This is in line with our results, which revealed that, the higher BMI level is associated with the future use of antibiotics. Older people are also more prone to infections, owing to age related immunosenescence [18]. It is supported by our findings because older age groups were more susceptible to antibiotics. Some surgeries, including neoadjuvant chemotherapy (NAC), have been known to put patients at risk of infections and thus require more antibiotics [19]. This is in agreement with our findings. Status of hormone receptors has an effect on treatment regimens and susceptibility of infection. Indicatively, hormone therapy is usually administered to ER-positive patients and impacts on immune responses [20]. Such diseases as diabetes and hypertension undermine the effectiveness of the immune system, exposing people to the risk of infection [21]. This is corroborated in this study where the relationship between comorbidities and the use of antibiotics is found to be significant. Studies have already confirmed that COVID-19 suppresses the immune system, which increases the likelihood of patients developing secondary infections [22]. This correlation is supported by our results. Prevention of SSIs is commonly achieved with the help of prophylactic antibiotics, the efficiency of which has been sufficiently reported [23]. This research justifies this practice because it has fewer complications on the antibiotic group. Because of the increased medical care, vaccinated people can be prescribed more antibiotics, which have been observed in recent studies [24].

Conclusion

This paper shows that the use of prophylactic antibiotics has a big influence on the outcome of the post-operative phase of breast cancer surgery. The results indicate that patient factors, such as age, BMI, presence of comorbidities, and vaccination, are important factors that predict the effectiveness of antibiotics and the risk of infection. Other important relationships identified by this analysis were between patient factors, the outcome after the operation, and the use of antibiotics. These results indicate the significance of individual patient-based approaches in the use of antibiotics.

Study Limitations

The single-center study limits the external validity of the results, and the comparative short-term follow-up can miss the protracted results. The strength of conclusions is further limited by the possibility of confounding factors caused by various surgical methods and the small sample on which to conduct subgroup analyses. Such restrictions demonstrate the importance of bigger, multicenter research with long-term follow-ups to gain a better understanding.

Recommendations

Standardized protocols on the administration of prophylactic antibiotics should be used in order to maximise the use of antibiotics and the outcome of patients, regular monitoring of bacterial resistance patterns should be conducted. Individual strategies depending on patient-specific risk factors such as BMI, age, and co-morbidities and specific infection control interventions in the high-risk population can increase efficacy. Long follow-up studies are necessary to assess the effects over time and strategies to enhance care provision.

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