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The Impact of Preoperative Chlorhexidine Baths on Outcomes in Pediatric Patients Undergoing Adnexal Surgery

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Abstract

Objective: Surgical site infections (SSIs) increase the risk of morbidity, mortality, and health care costs. Pre-operative bathing protocols with agents such as chlorhexidine 4% (CHG) have been implemented however the efficacy of this practice in adnexal surgery among pediatric patients is unknown.

Methods: We conducted a retrospective chart review of 115 non-neonatal, pediatric patients who underwent adnexal surgery from November 2017 to November 2022. Rates of SSIs, returns to emergency room (ER) and readmissions were compared for patients who did or did not receive a pre-operative antiseptic bath using CHG. Statistical analysis was conducted with statistical significance at $p<0.05$.

Results: The mean age at time of surgery was 13.3 years (range 0.75-20 years) with patients undergoing detorsion of adnexal structures and/or resection of adnexal masses or cysts. Over one quarter of our study population (26.1%) received a pre-operative bath with CHG. All patients underwent preparation of skin in the operating room just prior to incision with CHG and isopropyl alcohol skin preparation solution. Overall, the rate of SSIs was 1.8% (n=2) and there were no ER visits or readmissions due to SSIs. There was no significant difference in outcomes between pediatric patients undergoing pre-operative CHG bath with those not undergoing CHG bath prior to adnexal surgery.

Conclusion: Our data suggest that pre-operative bathing with CHG does not alter the rates of SSIs, ER visits or readmission rates for pediatric patients undergoing adnexal surgery. A larger multicenter prospective study would be required to determine a study sufficiently powered to make clinical recommendations.

Introduction

Surgical site infections (SSIs) represent a significant public health concern due to their association with an elevated risk of morbidity and mortality. Patients who develop SSIs often incur heightened healthcare expenditures attributed to prolonged hospitalization, emergency department visits, readmissions, and increased outpatient care utilization. In elective surgical contexts, the incidence of SSI ranges from 4.4% to 8.7%.[1] To alleviate the burden of SSI within our patient population, the standardization of perioperative care is imperative within the healthcare system.[2]The implementation of evidence-based practices for perioperative care standardization has the potential to enhance patient outcomes, particularly in terms of reducing surgical site infection rates.[3,4] Preoperative protocols encompass various elements, including umbilical cleansing and administration of antibiotics within one hour of incision.[3]

Preoperative bathing with an antiseptic agent, such as 4% chlorhexidine (CHG), is common practice in many institutions due to its bacteriostatic and bactericidal properties.[5,6] While some data supports preoperative bathing for specific surgical cases (e.g., orthopedic surgery, spine surgery, neurosurgery, colorectal surgery, and vascular surgery), its efficacy remains inconclusive for adnexal procedures involving benign conditions in the pediatric population. [7-10]

Despite the existing literature gap concerning the effectiveness of preoperative antiseptic cleansing with chlorhexidine for adnexal procedures related to benign etiologies, our institution has introduced a protocol mandating preoperative antibacterial cleansing using CHG for inpatients aged over 2 months or weighing more than 10 kilograms (kg), regardless of the surgical procedure, including adnexal procedures. However, this policy does not extend to outpatients undergoing similar surgeries from home or to patients arriving for surgery directly from the emergency room or referring hospital. The utility of preoperative CHG in the pediatric population is poorly defined within elective settings, and current recommendations lack specificity for this patient group. If a reduction in SSI rates is observed among patients undergoing preoperative antiseptic cleansing with chlorhexidine before adnexal procedures, the establishment of a universal, standardized policy applicable to all patients, whether inpatients or outpatients, could yield substantial benefits for both patients and the healthcare facility. Our study aims to assess the efficacy of preoperative CHG bathing in pediatric patients undergoing adnexal procedures for benign etiologies by comparing SSI rates between those who underwent preoperative CHG baths and those who did not.

Methods

All inpatients aged ≥ 2 months or weighing more than 10 kg, who are undergoing any surgical procedure at our institution, including adnexal procedures, are required to undergo pre-operative antibacterial cleansing using CHG 4%. However, patients who are directly admitted to the operating room (e.g., those coming from home, the emergency room, or a referring hospital) do not undergo pre-operative antibacterial cleansing. The aim of this retrospective chart review study was to evaluate the effectiveness of pre-operative CHG baths in the context of adnexal procedures for benign etiologies

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(e.g., cysts, non-malignant masses, and torsions) by comparing SSI rates between patients who received preoperative antiseptic cleansing and those who did not.

Charts of pediatric patients who underwent adnexal procedures for benign conditions, performed by a pediatric surgeon at our institution from November 2017 to November 2022, were collected. Descriptive statistics were computed for demographic and outcome variables. Categorical variables were assessed using Pearson's chi-square test or Fisher's exact test, while quantile regression was employed to compare the medians of continuous variables between the two groups. Categorical data results are presented as counts and proportions, and continuous variables are presented as medians and interquartile ranges (IQR). Results were considered statistically significant when $P < 0.05$. All analyses were carried out using Stata/SE 15.1

Results

Among them, approximately 26% (n=30) underwent preoperative antiseptic cleansing, while 74% (n=85) did not receive such cleansing prior to their surgery (Table 1). In both cohorts, the predominant ethnic background was Hispanic. Although no statistically significant differences were observed, the most prevalent indication for adnexal procedures among those who did not undergo CHG preoperative bathing was cysts and torsion (38.8%), while having a cyst without other indications was the most common indication among those who received CHG preoperative bathing (46.7%).

A majority of patients in both groups had a specimen removed (No CHG: 82.4% vs. CHG: 90.0%), and while differences in the rate of specimen removal and the type of specimens removed did not reach statistical significance, cysts were the most frequently removed type of specimen in both cohorts.

In our study population, the overall SSI rate was 1.8% as presented in (Table S1). Upon evaluating patient outcomes, our findings revealed no statistically significant differences between the two cohorts concerning various parameters, including hospital length of stay (LOS), the occurrence of post-operative SSI, and the choice of SSI intervention as outlined in (Table 2). It is noteworthy that only two patients in our study population developed SSI, and in both cases, antibiotics were administered as the SSI intervention. Notably, neither of the two SSI patients required an emergency room (ER) visit, office visit, or re-admission within 30 days post-operation.

The sole statistically significant discrepancy between the two cohorts pertains to the surgical approach. Our results indicated that patients who received a preoperative CHG bath were significantly more likely to have undergone laparoscopic surgery compared to those who did not receive such treatment (95.3% vs. 76.7%; P=0.007), as detailed in (Table 1).

Discussion

Surgical site infections in adnexal procedures for benign diseases have not been extensively documented. Our study, as presented in (Table S1), reports an SSI rate of 1.8%. While CHG baths may potentially contribute to SSI prevention in specific cases, their effectiveness within the pediatric population remains an underexplored area of research. To our knowledge, this study marks

Table 1: Demographics and Baseline Clinical Characteristics, by CHG Pre-Operative Bath Status

	No CHG Pre-Op Bath	CHG Pre-Op Bath	P-Value
N (%)	85 (73.9)	30 (26.1)	-
Age in years, Median (IQR)	14.0 (12.0-15.0)	13.0 (12.0-15.0)	0.064
BMI †	25.2 (21.0-30.3)	27.2 (20.1-32.6)	0.534
Race/Ethnicity			0.896
NH White	14 (16.5)	3 (10.0)	
NH Black	18 (21.2)	8 (26.7)	
NH Asian	2 (2.4)	0 (0.0)	
NH Other	5 (5.9)	2 (6.7)	
Hispanic	46 (54.1)	17 (56.7)	
Indication for Adnexal			0.350
Other	1 (1.2)	1 (3.3)	
Torsion	14 (16.5)	3 (10.0)	
Torsion & Other	1 (1.2)	1 (3.3)	
Non-Malignant Mass	4 (4.7)	3 (10.0)	
Cyst	26 (30.6)	14 (46.7)	
Cyst & Other	3 (3.5)	0 (0.0)	
Cyst & Torsion	33 (38.8)	7 (23.3)	
Cyst & Non-Malignant Mass	2 (2.4)	1 (3.3)	
Cyst, Non-Malignant Mass & Torsion	1 (1.2)	0 (0.0)	
Wound classification designated			0.827
Clean (1)	54 (63.5)	20 (66.7)	
Clean-Contaminated (2)	31 (36.5)	10 (33.3)	
Actual wound classification			1.000
Clean (1)	84 (98.8)	30 (100.0)	
Clean-Contaminated (2)	1 (1.2)	0 (0.0)	
Type of antibiotics administered pre-op			0.622
Ancef	46 (95.8)	17 (94.4)	
Zosyn	0 (0.0)	1 (5.6)	
Ceftriaxone	1 (2.1)	0 (0.0)	
Other	1 (2.1)	0 (0.0)	
Duration of antibiotics administered pre-op in days, Median (IQR)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	NE
Specimen removed			0.395
No	15 (17.6)	3 (10.0)	
Yes	70 (82.4)	27 (90.0)	
Type of Specimen Removed			0.524
None	15 (17.6)	3 (10.0)	
Other	4 (4.7)	0 (0.0)	
Solid Tumor	2 (2.4)	1 (3.3)	
Solid Tumor& Other	0 (0.0)	1 (3.3)	
Teratoma	4 (4.7)	3 (10.0)	
Cyst	56 (65.9)	21 (70.0)	
Cyst & Other	2 (2.4)	1 (3.3)	
Cyst & Solid Tumor	1 (1.2)	0 (0.0)	
Cyst & Teratoma	1 (1.2)	0 (0.0)	
Surgical approach			**0.007**
Laparoscopic	81 (95.3)	23 (76.7)	
Open	4 (4.7)	7 (23.3)	
Skin prep used at time of surgery			NE
Chloraprep	85 (100.0)	30 (100.0)	

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Type of antibiotics administered post-op			1.000
Clindamycin	1 (50.0)	1 (50.0)	
Other	1 (50.0)	1 (50.0)	
Duration of antibiotics administered post-op in days, Median (IQR)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	NE

CHG= pre-op antiseptic bath with chlorhexidine gluconate. IQR= Interquartile Range. NE= Not Estimable
† Among patients aged ≥ 2 years old
Column percentages are presented. Proportions may not add to 100% due to missing data and/or rounding errors
Bold face font denotes statistical significance at *P*< 0.05

Table 2: Patient Outcomes, by CHG Pre-Operative Bath Status

	No CHG Pre-Op Bath	CHG Pre-Op Bath	P-Value
Initial hospital length of stay in days, Median (IQR)	1.0 (0.0-1.0)	1.0 (1.0-2.0)	1.000
Development of SSI post-op			1.000
No	82 (97.6)	30 (100.0)	
Yes	2 (2.4)	0 (0.0)	
Type of SSI Intervention†			1.000
None	83 (97.6)	30 (100.0)	
Antibiotics	2 (2.4)	0 (0.0)	
ER visit for SSI within 30-day post-op †			
No	2 (100.0)	0 (0.0)	NE
Office visit for SSI within 30 days post-op †			
Yes	2 (100.0)	0 (0.0)	NE
Re-admission to the hospital within 30 days post-op †			
No	2 (100.0)	0 (0.0)	NE

CHG= pre-op antiseptic bath with chlorhexidine gluconate. IQR= Interquartile Range. NE= Not Estimable
† Among patients who developed SSI post-operatively
Column percentages are presented. Proportions may not add to 100% due to missing data and/or rounding errors
Bold face font denotes statistical significance at *P*< 0.05

the inaugural attempt to assess the utility of preoperative antiseptic chlorhexidine solutions in pediatric patients undergoing adnexal surgery.

Although CHG has demonstrated efficacy in reducing bacterial skin colonization, a Cochrane systematic review, incorporating data from 13 trials conducted between 1983 and 2011, did not show a benefit for chlorhexidine bathing or showering in various surgical procedures when compared to a placebo.[12] Similarly, our study revealed no significant difference in the rate and risk of SSI when utilizing CHG or not. In our cohort, only two patients developed surgical site infections, and both were effectively managed with antibiotic therapy without requiring readmission or reoperation.

In the pediatric population, some laparoscopic procedures have shown a reduction in SSI rates compared to open procedures, such as laparoscopic appendectomies (odds ratio of 2.22 [1.19, 4.15], p=0.01).[13]However, this is not universally applicable; for other procedures such as laparoscopic fundoplication for gastroesophageal reflux, inguinal hernia repair, or pyloromyotomy for pyloric stenosis, there is no difference in SSI rates.[13,14]Our study suggests that patients without a preoperative CHG bath were significantly more likely to have undergone laparoscopic surgery compared to those who had a preoperative CHG bath (95.3% vs. 4.7%, p-value 0.007). This finding can be attributed to the emergent nature of laparoscopic adnexal torsion treatment. Emergency surgeries do not undergo preoperative CHG baths to avoid further delays in care. Although further studies are warranted to assess differences in SSI rates in pediatric patients undergoing laparoscopic versus open procedures, our study concludes that the use of CHG does not significantly impact SSI rates regardless of the surgical approach.

A 2019 Cochrane review, based on very low certainty evidence in critically ill patients, highlighted the uncertainty regarding whether CHG baths reduce hospital-acquired infections, mortality, or length of stay, or whether chlorhexidine use leads to more skin reactions.[11] While preoperative bathing with CHG may serve as a cost-effective tool to reduce SSIs in specific surgical procedures, it is not without its risks. The National Center for Health Statistics reports that 27.2% of children have allergies, and allergic contact dermatitis has become increasingly prevalent in children in recent years.[15]CHG may cause a wide range of side effects, including skin irritation, allergic reactions (contact dermatitis, photosensitivity, anaphylaxis), eye problems upon direct contact, deafness if exposed to the tympanic membrane, stomach irritation/nausea if ingested, and acute respiratory distress syndrome (ARDS) if aspirated in high concentrations into the lungs. The FDA has identified 52 reported cases of anaphylaxis, a severe form of allergic reaction, associated with the use of chlorhexidine gluconate products applied to the skin from 1969 to 2015, and this figure does not encompass unreported cases or recent data.[16] Although our study does not investigate the incidence of adverse effects in our cohort, it is imperative to recognize that many children often suffer from childhood allergies and skin sensitivities that may be influenced by operative skin preparations. Our study concludes that the use of CHG baths prior to adnexal surgery for benign disease in pediatric patients does not significantly improve outcomes. Therefore, limiting exposure to potential allergens, such as CHG, may reduce complications and should be taken into account when devising hospital policies.

Our study is constrained by its retrospective nature, sample size, and reliance on data collected from a single institution. Additionally, risk factors known in adults to contribute to the development of SSIs, such as intraoperative temperature, operative time, and glycemic control, were not evaluated in this study. Furthermore, our study does not directly assess the side effects of SSIs or provide a cost analysis of preoperative chlorhexidine baths. Larger multicenter studies examining outcomes would enhance our understanding of whether preoperative antisepsis with CHG reduces postoperative SSI and readmission rates or holds any clinical benefit for pediatric patients. As part of the process for evaluating the quality and safety of care delivery, hospital policies must be critically reviewed.

Conclusion

This study suggests a 1.8% surgical site infection rate in pediatric patients undergoing adnexal surgery for benign conditions. The assessment of patient outcome parameters within our study population revealed that the use of a CHG preoperative bath did not result in statistically significant differences in the occurrence of SSI among pediatric patients undergoing adnexal procedures for benign

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etiologies. However, it's important to recognize that the utilization of CHG carries certain risks. Therefore, to enhance patient care and formulate clinical recommendations, further studies should be conducted.

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