OPEN

PRS GLOBAL OPEN

ORIGINAL ARTICLE
Reconstructive

Is Antibiotic Prophylaxis Necessary in Small (≤20% TBSA) Burn Excisions? A Retrospective Study

Joseph S. Puthumana, MD*
Iman F. Khan, MS, MPH*
Rafael Felix P. Tiongco, BA*
Arya A. Akhavan, MD*
Kimberly H. Khoo, MPH*
Cecil S. Qiu, MD*
Joe J. Puthumana, BS*
Carisa M. Cooney, MPH*
William F. Wright, DO, MPH†
Julie A. Caffrey, DO*

Background: This study investigates the effect of prophylactic perioperative antibiotic use on patients with small burns [≤20% total body surface area (TBSA)] on rates of infection, graft loss, or readmission.

Methods: A retrospective chart review was conducted on patients admitted to our institution's burn center between January 2020 and July 2021. Patients were included if they had a 20% or less TBSA burn with 1 or more operating room visit for burn excision and were excluded if a preoperative infection was present. Data were gathered regarding patient demographics, burn mechanism, burn characteristics, and outcome measures including infection, graft loss, and readmission. Statistical analysis was conducted by Mann–Whitney U and Fisher exact tests, and *P* values reported at two-sided significance of less than 0.05.

Results: There were no significant differences in age, body mass index, TBSA, percent third-degree burn, or comorbidities between patients who received (n = 29) or did not receive (n = 47) prophylactic perioperative antibiotics. There was a nonsignificant trend toward higher length of stay in the prophylactic antibiotic group, possibly driven by a nonsignificant trend toward higher rates of flame injuries in this group. There was no difference in infection ($P = 0.544$), graft loss ($P = 0.494$), or 30-day readmission ($P = 0.584$) between the two groups.

Conclusion: This study finds no significant difference in postoperative infection, graft loss, or 30-day readmission in two similar patient cohorts who received or did not receive prophylactic perioperative antibiotics for acute excision of small (≤20% TBSA) burns. *(Plast Reconstr Surg Glob Open 2022;10:e4388; doi: 10.1097/GOX.0000000000004388; Published online 21 June 2022.)*

INTRODUCTION

An estimated 486,000 burn injuries require medical treatment annually in the United States.[1] Encouragingly, the incidence of burn injuries in the United States has declined over the past two decades.[2] Increased survival rates in burn patients have been attributed to a steady shift in complex burn care away from clinics and community hospitals toward high-volume burn centers that focus on optimizing fluid resuscitation, wound care, metabolic support, and infection control.[3] Infection remains a major cause of morbidity and mortality in the burn population, as burns are particularly susceptible to rapid mobilization of bacteria due to disruption of normal immune function, inflammation, and metabolic disturbances, resulting in opportunity for hematogenous bacterial dissemination, multiorgan failure, and sepsis.[4–6] It is estimated that 36% of mortality in more than 20% total body surface area (TBSA) burns and 75% of mortality in more than 40% TBSA burns stem from infection.[7,8] Furthermore, complications from infection may prolong morbidity from burn injuries through graft loss, prolonged hospital stays, and increased readmissions.[5,9,10]

The current evidence regarding perioperative prophylactic antibiotic use is mixed. Several studies in patients with deep burns have demonstrated fewer donor site infections and fewer skin graft losses with antibiotic prophylaxis,[11,12] whereas other studies have reported no difference in graft take with or without perioperative antibiotics.[13,14] Bacteremia secondary to surgical excision is related to a TBSA greater than 45% and a burn injury older than 10 days, which suggests that antibiotic prophylaxis for small, acute burn excision and grafting may be unnecessary.[15]

*From the *Department of Plastic and Reconstructive Surgery, Johns Hopkins University School of Medicine, Baltimore, Md.; †Division of Infection Diseases, Department of Medicine, Johns Hopkins University School of Medicine, Baltimore, Md.*

Received for publication April 27, 2022; accepted May 4, 2022.

DOI: 10.1097/GOX.0000000000004388

Disclosures: *The authors have no financial interest to declare in relation to the content of this article.*

There are many risks associated with excessive antibiotic use in the burn population, including drug toxicity, *Clostridioides difficile* overgrowth, and the selection opportunity for the development of multidrug resistant bacteria such as *Staphylococcus aureus*, vancomycin-resistant enterococci, and *Pseudomonas* species.[8,16,17] It is important to weigh these risks against the benefits of administering antibiotics to prevent postoperative complications.

The limited and inconclusive evidence for or against the use of routine prophylactic antibiotics in small burn excisions tangibly affects clinical decision-making in many of the 50,000 burn admissions in the United States every year.[18] Aligning with recommendations from the antibiotic stewardship guidelines from the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America, antibiotic therapy should be based on patient-specific factors.[19] We believe that TBSA is an important patient-specific factor and investigated the effect of prophylactic perioperative antibiotic use on patients with small burns (TBSA ≤ 20%) on rates of infection, graft loss, and readmission.

METHODS

This study was approved by the institutional review board at our institution (IRB00289426). A retrospective chart review was conducted on 336 patients who were admitted to this institution's burn center between January 2020 and July 2021. Patients were excluded from final analysis if they had more than 20% TBSA burns, did not undergo burn excision, or if a preoperative infection was present. The final cohort size was 76 patients. Prophylactic perioperative antibiotic practices differ by attending surgeon at our burn center; therefore, patients were grouped by use or nonuse of perioperative antibiotics. Cause, location, and size of burn injuries were recorded, as well as detailed demographic information. Data on prophylactic antibiotic medication, dosage, and route were manually extracted from the medical record of each patient. Chart review was conducted on the 30-day postoperative window to capture mortality, readmission, graft loss, infection, and other complications (eg, pneumonia, central line-associated bloodstream infection, pulmonary embolism, etc.) as well as associated wound culture results and antibiotic management if available.

All statistical analysis was conducted using SPSS software (Version 27, IBM Corp, Armonk, NY). Frequencies and percentages were calculated for each categorical variable, and means with SD were calculated for each continuous variable. The Fisher exact test was used to determine significance in categorical variables across the two prophylaxis groups, and Mann–Whitney U was used in continuous variables; *P* values were reported at two-sided significance of *P* less than 0.05.

RESULTS

A total of 76 patients with less than or equal to 20% TBSA burns who underwent burn excision were identified. Fewer patients received prophylactic perioperative antibiotics (n = 29, 38.2%) than those who did not (n = 47, 61.8%). The perioperative antibiotic most often administered was cefazolin (n = 27, 93.1%), and in a minority of cases, vancomycin (n = 2, 6.9%).

Takeaways

Question: Do prophylactic antibiotics impact infection, graft loss, or readmission in small burns?

Findings: There were no significant differences in age, body mass index, TBSA, percentage third-degree burn, or comorbidities between patients who received or did not receive prophylactic perioperative antibiotics. There was no difference in infection, graft loss, or 30-day readmission between the two groups.

Meaning: This study finds no significant difference in outcomes in two similar patient cohorts, suggesting that prophylactic antibiotics may be an unnecessary risk for acute excision of small burns.

Demographic

The groups that received and did not receive prophylactic antibiotics were similar in median age (57.0 versus 55.0 years, $P = 0.571$), body mass index (26.3 versus 26.8, $P = 0.589$), and relevant comorbidities, including diabetes mellitus (24.1% versus 25.5%, $P = 0.558$), hypertension (31.0% versus 31.9%, $P = 0.572$), and smoking status (37.9% versus 31.9%, $P = 0.626$) (Table 1).

Injury

The groups that received and did not receive prophylactic antibiotics did not differ by median TBSA (5.0% versus 5.0%, $P = 0.900$) or percentage of third-degree burn (0.0% versus 0.0%, $P = 0.520$). There was no significant difference in the cause of burns between the two groups, but there were a higher rate of flame burns and a lower rate of scald burns in the prophylaxis group ($P = 0.202$). There was no difference in median length of stay between prophylaxis groups (13.0 days versus 11.0 days, $P = 0.444$). The two groups did not differ significantly in anatomic location of burn compared in the head and neck ($P = 0.254$), trunk and buttocks ($P = 1.00$), arms ($P = 0.276$), hands ($P = 0.756$), or legs ($P = 0.244$) (Table 1).

Complications

Three primary outcomes were examined in this study: infection, graft loss, and 30-day readmission. There was no significant difference between the two groups in infection ($P = 0.544$), graft loss ($P = 0.494$), or 30-day readmission ($P = 0.584$) (Table 2).

DISCUSSION

This study attempts to determine whether prophylactic perioperative antibiotics are necessary for small (≤20% TBSA) acute burn excisions. We found no difference in postoperative infection, graft loss, or 30-day readmission across two highly similar groups—in age, comorbidity, and extent of burn—regardless of prophylactic antibiotic administration.

Table 1. Demographics, Comorbidities, and Burn Injury Characteristics by Prophylaxis Group

	Prophylaxis	No Prophylaxis	*P*
Patient and Burn Characteristic	**Demographic and Comorbidity**		
Age	57.0 (34.0–64.5)	55.0 (39.0–66.0)	0.571
Body mass index	26.3 (22.9–30.1)	26.8 (23.2–32.3)	0.589
Diabetes mellitus	24.1%	25.5%	0.558
Hypertension	31.0%	31.9%	0.572
Smoker	37.9%	31.9%	0.626
Burn extent and anatomy			
TBSA	5.0% (2.0–9.8)	5.0% (2.0–10.0)	0.900
Third degree	0.0% (0.0–2.8)	0.0% (0.0–2.0)	0.520
Head and neck	3.0% (1.5–4.0)	3.8% (2.8–5.5)	0.254
Trunk and buttock	4.0% (1.4–7.5)	3.0% (1.5–7.0)	1.000
Arms	1.7% (1.0–4.0)	3.0% (2.0–4.1)	0.276
Hands	1.0% (0.9–2.0)	1.0% (1.0–1.0)	0.756
Legs	5.0% (2.0–7.0)	3.0% (1.0–6.5)	0.244
Burn cause			
Scalds	27.6%	40.4%	0.202
Flame	44.8%	29.8%	
Contact	20.7%	17.0%	
Chemical	0.0%	10.6%	
Electric	3.4%	0.0%	
Discharge			
Home	78.70%	72.40%	0.980
SNF	14.6%	15.2%	
Hospice	2.4%	3.0%	
Death	2.4%	3.0%	
Inpatient psych	0.0%	3.0%	
Against medical advice	2.4%	0.0%	
Length of stay	13.0 (9.0–19.5)	11.0 (8.0–16.0)	0.444

Continuous variables expressed as median (IQR) and categorical as percentage.
IQR, interquartile range; SNF, skilled nursing facility.

Perioperative antibiotics are often used in cutaneous surgery for extensive burn injuries, during which the large surface area of the surgical site and altered physiology puts the patient at high risk of local and systemic infection.[11,12,15] However, no standardized data exist for prophylactic use of antibiotics in small burns, a scenario in which these risks are reduced. The potential reduction in infectious risk must be weighed against practicing antibiotic stewardship to preserve effective therapies for multidrug-resistant organisms, particularly in the susceptible burn population.[20,21] This study found no difference in three crucial postoperative measures of success in burn surgery: infection, graft loss, and 30-day readmission, suggesting that systemic antibiotic use in small burn excision may be reasonably foregone.

This finding reflects previous work done in pediatric patients, which showed that routine antibiotic prophylaxis was unnecessary in the era of early excision and closure of burns,[12–14] and more recent work, which showed no effect of perioperative antibiotic prophylaxis on the incidence of bacteremia graft loss, or surgical site infection.[22] The unique practice patterns at our institution—where initial excision is randomized by surgeon call schedule and where some surgeons routinely request prophylactic antibiotics in small burn excisions and others do not—provide a natural comparison group for retrospective review. This study captured extensive demographic, comorbidity, and injury data to ensure that the decision to prescribe prophylactic antibiotics was attributable to surgeon preference rather than clinical context. The prominent similarity between the two groups in age, comorbidities, burn size, anatomic burn location, and discharge status reinforces that the prophylaxis and no-prophylaxis groups are clinically similar and that the noninferiority findings are clinically meaningful.

Table 2. Outcomes in Patients Who Received or Did Not Receive Prophylactic Perioperative Antibiotics

Outcomes	Prophylaxis	No Prophylaxis	*P*
Postoperative infection			
Y	3 (10.3%)	4 (8.5%)	0.544
N	26 (89.7%)	43 (91.5%)	
Graft loss			
Y	2 (6.9%)	2 (4.3%)	0.494
N	27 (93.1%)	45 (95.7%)	
30-d readmission			
Y	2 (6.9%)	4 (8.5%)	0.584
N	27 (93.1%)	43 (91.5%)	

This study identified patients using a prospectively maintained institutional database. However, it is limited by its retrospective chart review design in capturing antibiotic prophylaxis data and subsequent complications. Detailed antibiotic administration data were collected from anesthesia notes, but the use of topical antibiotics in postoperative care was not analyzed. The most important limitation in this study is the restricted sample size of 76 patients. In particular, the overall rate of complications and readmission was relatively low, limiting the power of findings. However, the noninferiority of infections, graft loss, and readmission between the two highly similar cohorts in this retrospective study provides justification for a prospective, randomized trial for gold-standard data that can standardize prophylactic antibiotic practices in small burn excisions throughout the country.

CONCLUSIONS

In our cohort-matched retrospective review of 76 burn patients with small burns, we found no difference in outcomes between patients who did and did not receive

prophylactic antibiotics. Although the power of the study is low, we feel that the results provide adequate justification for a practice-altering prospective trial to further characterize the use or nonuse of antibiotic prophylaxis in small burns.

Joseph S. Puthumana, MD
Department of Plastic and Reconstructive Surgery
Johns Hopkins University
601 N Caroline St, Baltimore, MD 21287
E-mail: jputhum2@jhmi.edu

REFERENCES

1. American Burn Association. Burn incidence fact sheet. [published May 8, 2017]. Available at https://ameriburn.org/who-we-are/media/burn-incidence-fact-sheet/. Accessed December 22, 2021.
2. Crowe CS, Massenburg BB, Morrison SD, et al. Trends of burn injury in the United States: 1990 to 2016. *Ann Surg.* 2019;270:944–953.
3. Klein MB, Goverman J, Hayden DL, et al; Inflammation and Host Response to Injury, and Large-Scale Collaborative Research Program. Benchmarking outcomes in the critically injured burn patient. *Ann Surg.* 2014;259:833–841.
4. Sharma BR. Infection in patients with severe burns: causes and prevention thereof. *Infect Dis Clin North Am.* 2007;21:745–759, ix.
5. Zhang P, Zou B, Liou YC, et al. The pathogenesis and diagnosis of sepsis post burn injury. *Burns Trauma.* 2021;9:tkaa047.
6. Corcione S, Lupia T, De Rosa FG; Host and Microbiota Interaction Study Group (ESGHAMI) of the European Society of Clinical Microbiology and Infectious Diseases (ESCMID). Microbiome in the setting of burn patients: implications for infections and clinical outcomes. *Burns Trauma.* 2020;8:tkaa033.
7. Fitzwater J, Purdue GF, Hunt JL, et al. The risk factors and time course of sepsis and organ dysfunction after burn trauma. *J Trauma.* 2003;54:959–966.
8. Church D, Elsayed S, Reid O, et al. Burn wound infections. *Clin Microbiol Rev.* 2006;19:403–434.
9. Unal S, Ersoz G, Demirkan F, et al. Analysis of skin-graft loss due to infection: infection-related graft loss. *Ann Plast Surg.* 2005;55:102–106.
10. Eidelson SA, Parreco J, Mulder MB, et al. Variation in national readmission patterns after burn injury. *J Burn Care Res.* 2018;39:670–675.
11. Ramos G, Resta M, Machare Delgado E, et al. Systemic perioperative antibiotic prophylaxis may improve skin autograft survival in patients with acute burns. *J Burn Care Res.* 2008;29:917–923.
12. Griswold JA, Grube BJ, Engrav LH, et al. Determinants of donor site infections in small burn grafts. *J Burn Care Rehabil.* 1989;10:531–535.
13. Sheridan RL, Weber JM, Pasternack MS, et al. Antibiotic prophylaxis for group A streptococcal burn wound infection is not necessary. *J Trauma.* 2001;51:352–355.
14. Alexander JW, MacMillan BG, Law EJ, et al. Prophylactic antibiotics as an adjunct for skin grafting in clean reconstructive surgery following burn injury. *J Trauma.* 1982;22:687–690.
15. Mozingo DW, McManus AT, Kim SH, et al. Incidence of bacteremia after burn wound manipulation in the early postburn period. *J Trauma.* 1997;42:1006–1010.
16. Wibbenmeyer L, Danks R, Faucher L, et al. Prospective analysis of nosocomial infection rates, antibiotic use, and patterns of resistance in a burn population. *J Burn Care Res.* 2006;27:152–160.
17. Ventola CL. The antibiotic resistance crisis: part 1: causes and threats. *P T.* 2015;40:277–283.
18. Nguyen TT, Gilpin DA, Meyer NA, et al. Current treatment of severely burned patients. *Ann Surg.* 1996;223:14-25.
19. Barlam TF, Cosgrove SE, Abbo LM, et al. Implementing an antibiotic stewardship program: guidelines by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America. *Clin Infect Dis.* 2016;62:e51–e77.
20. Altoparlak U, Erol S, Akcay MN, et al. The time-related changes of antimicrobial resistance patterns and predominant bacterial profiles of burn wounds and body flora of burned patients. *Burns.* 2004;30:660–664.
21. Leseva M, Arguirova M, Nashev D, et al. Nosocomial infections in burn patients: etiology, antimicrobial resistance, means to control. *Ann Burns Fire Disasters.* 2013;26:5–11.
22. Hill DM, Guido A, Sultan-Ali I, et al. A non-inferiority study comparing efficacy of preoperative prophylactic antibiotics for preventing infectious complications in patients with less severe burns. *Burns.* 2021;47:67–71.