flame burns, 22 (5.58%) had electrical burns, 3 (0.76%) were burned from embers, 2 (0.05%) had frostbite, 2 (0.05%) had hot object contact burns, and 1 patient (0.02%) each had burns due to tandoori, grape leaves, or green walnuts (Table 1). Burn injuries were seen mostly in the right lower extremity of 209 (53.04%) patients and in the left lower extremity of 194 (49.23%) patients (Table 1).

Table I: General information About the Patients

Patient		number	percent	all patients %	p value
sex	man	217	55%	56.4%	0.387
	women	177	45%	43.6%	
age group	0-4 ages	224	5,8%	53.2%	0.012
	5-9 ages	39	9.9%	12.5%	
	10-14 ages	14	3.5%	5.0%	
	15-24 ages	37	9.4%	8.9%	
	25-34 ages	30	7.6%	7.7%	
	35-44 ages	17	4.3%	4.8%	
	45-64ages	23	5.8%	5.5%	
	65+	10	2.5%	2.4%	
Application Place	emergency	194	49.2%	49.75%	
	policlinic	200	50.8%	50.25%	
	1 or more day delay	110	27.9%	23.1%	
place of residence	rural	201	51.0%	47.85%	0.065
	urban	193	49.0%	52.15%	
season	winter (December, January, February)	105	26.64%	24.02%	
	spring (March, April, May)	87	22.08%	25.72%	
	summer (June, July, August)	84	21.32%	24.17%	
	autumn (September, October, November)	118	29.95%	26.09%	
Cause of burns	scalding burns	317	80.45%	76.60%	
	flame burns	45	11.42%	9.18%	
	electrical burns	22	5.58%	3.67%	
	embers burns	3	0.76%		
	asphalt burns	2	0.05%		
	frostbite	2	0.05%	0.03%	
	hot object conract burns	2	0.05%		
	tandoori	1	0.02%		
	grape leaf burn	1	0.02%		
	green walnut	1	0.02%		
Location of burns	head-neck	76	19.28%	21.41%	p:0.14
	upper right extremity	133	33.75%	32.08%	p:0.40
	upper left extremity	132	33.5%	32.79%	p:0.159
	front chest + abdomen	112	28.42%	27.85%	0.202
	posterior chest + lumbar region	35	8.88%	7.63%	0.197
	Perineum	29	7.36%	5.30%	0.36
	Lower right extremity	209	53.04%	42.54%	0.152
	lower left extremity	194	49.23%	40.56%	0.52
Burn degree			2.67(min:2-max:4)	2.64(min:2-max:4)	0.04
% burned			14.18(min:2-max:50%	9.22(min:1-max:50) %	0.083
length of stay in hospital			12.88(min:1-max:39)	6.0 gün(min:1-max:39)	

The average burn degree was 2.67 (min: 2–max: 4). The burn percentage average was 14.18% (min: 2–max: 50). Laboratory test results of the white blood cells (WBC) and C-reactive protein

(CRP) were 13.6 ± 7.13 and 29.49 ± 21:25 respectively.

In the wound culture results, 70.55% were gram (+) and 28.68% were gram (-) bacteria. C. albicans was found in wound culture growths at a rate of 0.07%. S. aureus was the most common gram (+) bacteria with 23.09% (n = 91). The most common gram (-) bacteria were E. coli with 9.13% (n = 36) and P. aeruginosa with 9.13% (n = 36) (Table 2).

Table II: Wound Site Culture Results

Bacteria genus	Species	NUMBER	PERCENT
GRAM(-)		**113**	**28.68**%
Escherichia	coli	36	9.13%
Enterobacter	aerogenes	4	1.01%
	cloacae	6	1.52%
Pseudomonas	aeruginosa	36	9.13%
	flourescens	1	0.02%
	putida	2	0.50%
Acinetobacter	Baumannii	8	2.03%
Proteus	mirabilis	6	1.52%
Klebsiella	pneumoniae	5	1.26%
Pantoea	agglomerans	3	0.07%
Serratia	marcescens	2	0.50%
Sphingomonas	paucimobilis	2	0.50%
Aeromonas	Hydrophila	1	0.02%
Burkholderia	cepacia	1	0.02%
GRAM (+)		**278**	**70.55**%
Staphylococccus	aureus	91	23.09%
	capitis	3	0.07%
	epidermidis	76	19.28%
	haemolyticus	27	6.85%
	hominis	33	8.37%
	lugdunensis	1	0.02%
	pseudintermedius	1	0.02%
	saprophyticus	2	0.50%
	simulans	1	0.02%
	warneri	2	0.50%
	xylosuse	5	1.26%
Streptococcus	spp	4	1.01%
	pyogenes	3	0.07%
	agalactiae	1	0.02%
Enterococcus	avium	1	0.02%
	faecalis	18	4.56%
Kocuria	kristinae	3	0.07%
	rosea	1	0.02%
Lactococcus	garvieae	1	0,02%
Micrococcus	lylae	1	0.02%
YEAST		**3**	**0.07**%
Candida	albicans	3	0.07%
TOTAL		**394**	**100**

In the wound culture results of the patients who arrived late (≥ 1 day following their burn), the most gram (+) results were 65.14%. Among these, the most common was S. aureus with 20.18% (Table 3).

Table III: Cultural Results in Patients Arriving Late For 1 Day or Mo

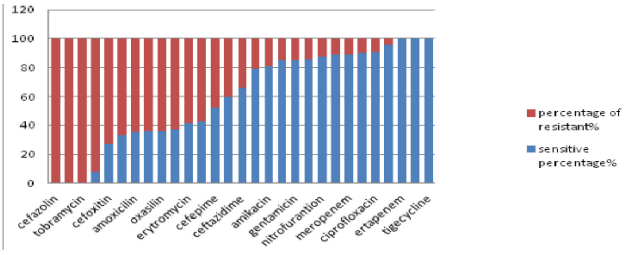
Bacteria genus	**Species**	**NUMBER**	**PERCENT**
Gram(-)		**38**	**34.86**%
Acinetobacter	baumannii	2	1.83%
Escherichia	coli	10	9.17%
	faecalis	7	6.42%
Klebsiella	pneumoniae	2	1.83%
Pantoea	agglomerans	1	0.91%
Proteus	mirabilis	3	2.75%
pseudomonas	aeruginosa	10	9.17%
	putida	2	1.83%
serratia	marcescens	1	0.91%
Gram(+)		**71**	**65.14**%
enterococcus	avium	1	0.91%
kocuria	kristinae	1	0.91%
lactococcus	garvieae	1	0.91%
staphylococccus	aureus	22	20.18%
	epidermidis	17	15.59%
	haemolyticus	9	8.25%
	hominis	12	11.0%
	lugdunensis	1	0.91%
	xylosus	2	1.83%
streptococcus	Spp.	2	1.83%
	agalactiae	1	0.91%
	mutis	1	0.91%
	pyogenes	1	0.91%
Total		**109**	**100**%

We had 19 patients who had to be followed up in the intensive care center because of the infection clinic. The mean length of stay in the intensive care unit was 11 days (min: 2–max: 36). Gram (+) organisms were isolated with the highest rate of 78.95% in the culture results of patients in need of intensive care. S. aureus was the most common organism with 21.05% (Table 4).

Table IV: Pathogens Insulated in Cultural Results in Patients in Intensive Care

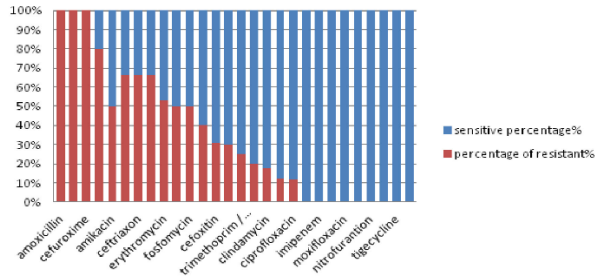
Bacteria genus	Species	NUMBER	PERCENT
Gram(-)		**4**	**21.05**%
acinetobacter	baumannii	1	5.26%
escherichia	coli	2	10.52%
proteus	mirabilis	1	5.26%
Gram(+)		**15**	**78.95**%
enterococcus	feacilis	1	5.26%
staphylococcus	aerous	4	21.05%
	epidermidis	8	42.10%
	heamolyticus	1	5.26%
	hominis	1	5.26%
Total		**19**	**100**%

In the antibiogram of Staphylococcus, which was the most common bacterium in our culture results, the antibiotics to which it was most resistant were cefazoline, tobramycin, and cefoxitin. Antibiotics to which it was most sensitive included moxifloxacin, teicoplanin, imipenem, and colistin (Figure 1).



Figüre 1: Staphylococcus antibiotic sensitivity

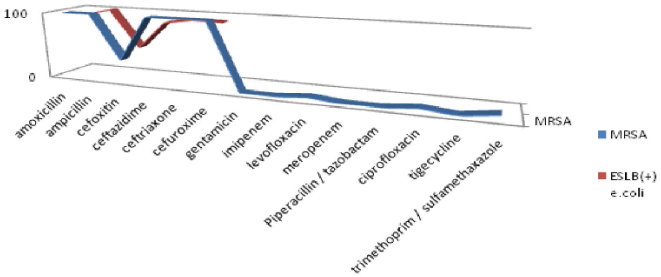
E. coli was one of the most common gram (-) bacteria in our culture results, it was the most resistant to cefuroxime, amoxicillin, oxacillin, and ampicillin. Antibiotics to which it was most sensitive to were ertapenem, meropenem, netilmicin, and teicoplanin (Figure 2).



Figüre 2: Escherichia coli antibiotic sensitivity

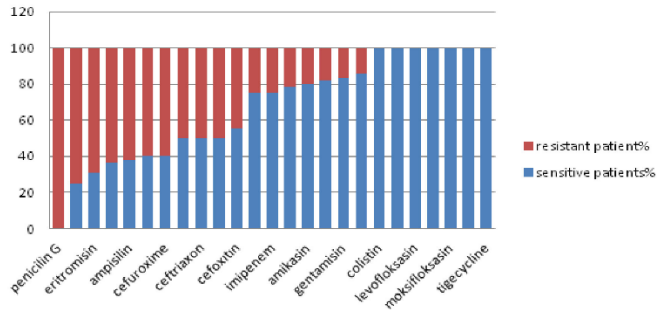
The resistance rate of all Staphylococcus to methicillin was 24.80%, and the resistance rate of S. aureus to methicillin was 20.31%. Our rate of extended spectrum beta-lactamase (ESBL) (+) E. coli was 36.11%.

Percentages of resistance to methicillin-resistant Staphylococcus aureus (MRSA) and ESBL (+) E. coli microorganisms included the penicillin and cephalosporin group of antibiotics. This resistance showed rates of almost 100%. This group of bacteria was more sensitive to antibiotics like piperacillin/tazobactam and trimethoprim/sulfamethoxazole (Figure 3).



Figüre 3: MRSA and ESBL (+) E.coli resistance percentages

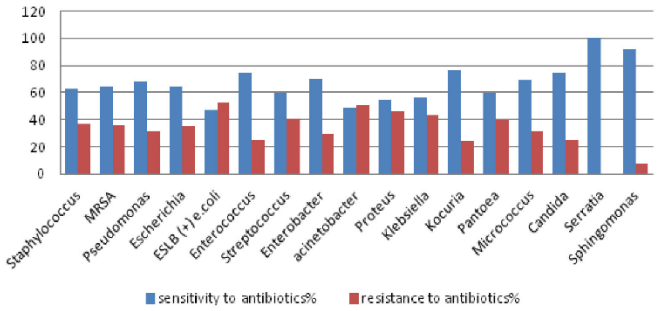
The antibiotics to which Pseudomonas, which was the most prominent of the gram (-) pathogens, were most resistant to in the antibiogram were penicillin G, erythromycin, and ampicillin. Antibiotics to which it was most sensitive to included tigecycline, moxifloxacin, levofloxacin (Figure 4).



Figüre 4: Pseudomonas antibiotic sensitivity

The average antibiotic sensitivity rate of Staphylococcus, which was the most common gram (+) bacteria, was 62.6% and the resistance

rate to antibiotics was 37.4%. The average antibiotic sensitivity rates of Escherichia and Pseudomonas, which were among the most common gram (-) bacteria, were 64.9% and 68.1%, respectively. Moreover, their resistance rates to antibiotics were 35.1% and 31.9%, respectively (Figure 5).



Figüre 5: Susceptibility and resistance percentages to microorganism

The average length of stay was 12.86 ± 17.34 (range: 1–39) days. Of the total number of patients, 21 (1.48%) died, two from insufficient fluid replacement in the first 24 hours and the 19 from wound site infections.

DISCUSSION

Wound infection treatment is important in burns. Because wound infection in burns causes prolongation length of hospital stay, sepsis, and even mortality. Wound site infectious diseases are the diseases caused by the proliferation and the invasion of microorganisms on wound sites. It is essential to know the risk factors and treatment of wound infections, which continues to be one of the most important problems of modern burn treatment. With the antibiotic resistance developing in the world, it is important to know the effective antibiotic to be used against microorganisms in the burn wounds.

Datta S.[16] and Meroj A. et al.[17], more women than men affected by the burn injury. However, in our study, it was observed that males (55%) were affected more than females (45%) from burn injuries.This result is consistent with studies by Saaiq M.[18] and Chaudhary N. Ave[19].The reason for this may be more exposure to occupational hazards of the men; Therefore, the risk of burns is higher than women.

Our study involved patients of all ages. The most common cause of burn injuries varied by age groups. While scalding burns and hot object contact burns are mostly seen in children in our region, scald burns, electrical burns, flame burns, chemical burns were observed in mostly adult groups. The age group with the most wound culture (+) was the 0–4 age group, consistent with the study by Tekin Recep et al.[20]. The reason for this is the most active years occur in the 0–5 age group who generally do not recognize the dangers of their environment. While the burned TBSA was 2%–50% in patients hospitalized in our study, Saaiq M. et al. reported 5–40%[18], and 3–93% in the study by Chaudhary N. A. et al.[19].

In our study, the most common cause of burns was scalding, followed by flame and electrical burns. Saaiq M.[18]. and Chaudhary N.A[19]. et al. Reported that the most common cause of burns was flame burns. The reason for the higher rate of scalding burns in our study was because families with many children have more unprotected contact with hot liquids in the kitchen. Therefore, we think scalding burns occurred more frequently due to this environment.

Based on data from the Central Asian and Eastern Europe Antimicrobial Resistance Surveillance (CAESAR) study, S. aureus ranks third among the most frequently isolated microorganisms from invasive samples in our country[21,22]. In the 2017 CAESAR study, the rate of MRSA in our country was 26%[21].

S. aureus was the most common (23.09%) cause of wound culture (+) results in our study. S. aureus was resistant to 20.31% methicillin. Our methicillin resistance rate was close to the that of the CAESAR study. We attribute the lower

level in our study to the use of antibiotics that were dependent on the culture results.

According to the results of the antibiotic sensitivity tests in our study, the antibiotics most sensitive to MRSA were ciprofloxacin, piperacillin/tazobactam, and trimethoprim/sulfamethoxazole.

In our study, the most common microorganism isolated from burn wounds was S. aureus, followed by gram (-) pathogens P. aeruginosa and E. coli. Mehta M., Tekin Recep et al.[23,24] and its results are inconsistent with our results. Mehta M. et al. The rates of P. aeruginosa and E. coli were 52% and 10.0%, respectively. According to research conducted by Al Laham et al, P. aeruginosa and E. coli rates were 52.0% and 9.0 %, respectively. In our study, the rates of P. aeruginosa and E. coli were 9.13% and 9.13%, respectively. In studies carried out by Mehta M et al., the P. aeruginosa resistances to gentamicin amikacin and ciprofloxacin were high (40%–75%). In our study, this rate was lower (16%–19%). In the study by Rahman M. et al., The rate of ESBL (+) E. coli found in burn wound cultures is 45.5%[25]. In our study, this rate was lower by 36.11%.

Various potential risk factors have been investigated for their role in burn wound colonization in burn centers[26]. When we compared the positive culture results of male patients to all male patients admitted to our burn center (56.4% vs. 55.0%, respectively), the positive culture results of female patients to to all female patients admitted to our burn center (43.6% vs. 43.0%, respectively) were not in agreement. We think that the male sex plays a (+) role in the outcome of the culture, however this was not statistically significant (p = 0.387).

The percentage of patients coming from rural and city centers was 47.85% and 52.15%, respectively. This ratio was 51.0% and 49.9% in those who had (+) wound culture results. We think that residing in rural areas increases the rate of wound infection. However, this was not statistically significant (p = 0.065).

We found that the upper and lower extremities were more commonly contaminated than other areas. In particular, the percentage of perineal infections increased more than the general patient rate. The perineal burn rate in all patients vs. the perineal burn rate in infected patients was 5.3% vs. 7.36%, respectively. This was not a statistically significant difference (p = 0.36).

The risk of a (+) wound culture increases as the TBSA increases, with an average of 14.18% (min: 2–max: 50) and 9.22% (min: 1–max: 50) in all patients with culture results. But this difference was not significant (p = 0.083).

CONCLUSION

This study is the first large-scale study conducted in our region to compare the results of organisms that cause burn wound infections. Recently, due to increased antibiotic resistance, duration of stay in hospital of patients with increasing morbidity and mortality rates. As a result of our study, we found that the most common causes of burn infections in our region were caused by S. aureus, P. aeruginosa and E. coli. We hope that the use of broad-spectrum antibiotics that can be effective against these bacteria will contribute to clinical treatments until culture results are obtained. Thus, it avoids the unnecessary use of antibiotics we hope to reduce the rate of resistance to antibiotics in southeast of turkey.

Study limitations

The most important factors limiting our study are the retrospective nature of our study.

Ethics Committee Approval: The study was conducted between January 2010 and January 2020 in accordance with the principles of the 2008 revision of the Declaration of Helsinki, and approval was obtained prior to the study from the local ethics committee for retrospective research (Gazi Yaşargil Training and Research Hospital Ethics Committee/02.07.2021/E-810).

Conflict of Interest: The authors declared no conflicts of interest.

Financial Disclosure: The authors declared that this study has received no financial support.

REFERENCES

1. Burns. (2018). Accessed: May 27, 2019: http://www.who.int/news-room/factsheets/detail/burns.

2. GBD 2015 Disease and Injury Incidence and Prevalence Collaborators: Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet. 2016,388:1545-602. 10.1016/S0140-6736(16)31678-6

3. Pruitt BA Jr, McManus AT, Kim SH, et al: Burn wound infections: Current status .World J Surg. 1998, 22:135-45. 10.1007/s002689900361

4. Weber JM, McManus AT, Nursing Committee of the International Society for Burn Injuries: Infection control in burn patients. Burns. 2004, 30: A16-24. 10.1016/j.burns.2004.08.003

5. Farina JA, Rosique MJ, Rosique RG: Curbing inflammation in burn patients. Int J Inflam. 2013, 2013:715645. 10.1155/2013/715645

6. Church D, Elsayed S, Reid O, et al: Burn wound infections. Clin Microbiol Rev. 2006, 19:403-34. 10.1128/CMR.19.2.403-434.2006

7. Raz-Pasteur A, Hussein K, Finkelstein R, et al: Blood stream infections (BSI) in severe burn patients--early and late BSI: a 9-year study. Burns. 2013, 39:636-42. 10.1016/j.burns.2012.09.015

8. Burn Wound Infections. (2011). Accessed: August 31, 2013: http://search.medscape.com/search/?q=Burn%20Wound%20Infections.

9. 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, 54:959-66. 10.1097/01.TA.0000029382.26295.AB

10. Rafla K, Tredget E: Infection control in the burn unit . Burns. 2011, 37:5-15. 10.1016/j.burns.2009.06.198

11. Weinstein RA, Mayhall CG: The epidemiology of burn wound infections: then and now . Clin Infect Dis. 2003, 37:543-50. 10.1086/376993

12. Antibiotic Resistance Threats in the United States, 2013. (2013). Accessed: December 25,2018: http://www.cdc.gov/drugresistance/threat-report-2013/pdf/ar-threats-2013-508.pdf.

13. Demir Yiğit, Yasemin, and Ebral Yiğit. "Flame burns." Dermatologic therapy 34.6 (2021): e15133.

14. Ventola CL: The antibiotic resistance crisis. Part 1: causes and threats . P T. 2015, 40:277-83.

15. Greenhalgh DG, Saffle JR, Holmes JH 4th, et al.: American Burn Association consensus conference to define sepsis and infection in burns. J Burn Care Res. 2007, 28:776-90. 10.1097/BCR.0b013e3181599bc9

16. Datta S, Ghosh T, Sarkar D, et al: Bacteriological profile of burn wounds and their antibiotic susceptibility pattern in a tertiary care hospital. Int J Sci Stud. 2016, 4:141-45.

17. Meroj A. Jasem et al. The most frequent bacterial infections in burn injuries at burn units of two hospitals in Baghdad. Iraqi Journal of Public Health (2018) 2:1

18. Saaiq M, Ahmad S, Zaib MS: Burn wound infections and antibiotic susceptibility patterns at Pakistan Institute of Medical Sciences, Islamabad, Pakistan. World J Plast Surg. 2015, 4:9 15.

19. Chaudhary N A, Munawar M D, Khan M T, et al. (June 01, 2019) Epidemiology, Bacteriological Profile, and Antibiotic Sensitivity Pattern of Burn Wounds in the Burn Unit of a Tertiary Care Hospital. Cureus 11(6):e4794. DOI 10.7759/cureus.4794.

20. Tekin, R., et al. "The evaluation of patients with burns during fifteen years period." Clin Ter 164.5 (2013):385-9.

21. "Central Asian and Eastern European Surveillance of Antimicrobial Resistance. Annual report 2018". http://www.euro.who.int/en/health topics/diseaseprevention/antimicrobialresistance/publications/2018/central-asian-andeastern-european-surveillance-of-antimicrobialresistance-annual-report-2018.

22. Tekin, Recep, et al. "Risk factors for nosocomial burn wound infection caused by multidrug resistant Acinetobacter baumannii." Journal of Burn Care & Research 35.1 (2014): e73-e80.

23. Mehta M, Dutta P, Gupta V: Bacterial isolates from burn wound infections and their

antibiograms: a eight-year study. Indian J Plast Surg. 2007, 40:25-28. 10.4103/0970-0358.32659

24. Tekin, Recep, et al. "An evaluation of pediatric burn patieints a fifteen-years period." Turkish Journal of Trauma and Emergency Surgery 18.6 (2012): 514-8.

25. Mostaqimur Rahman, Hafiza Sultana , Md. Abdullahil Mosawuir , Status of Extended Spectrum Beta-Lactamase (ESBL) Producing Bacteria Isolated from Surgical and Burn Wound at Tertiary Care Hospital in Dhaka City, Bangladesh Journal of Infectious Diseases June 2018, DOI: http://dx.doi.org/10.3329/bjid.v5i1.37712

26. Air temperature in Turkey's southeast region of Anatolia: www.mgm.gov.tr 2020.