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ORIGINAL ARTICLE

An Investigation into Bacterial Bloodstream Infections and Antibiotic Resistance Profiles in a Tertiary Hospital for a Ten-Year Period

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SUMMARY

Background: **Bloodstream infections are one of the major causes of healthcare-associated morbidity and mortality. The present study aims to investigate the prevalence of the microorganisms isolated from blood cultures and to evaluate susceptibilities to antimicrobial agents in a tertiary center, Gulhane Training and Research Hospital, Ankara, Turkey.**

Methods: **Blood cultures (BCs) were incubated in BACTEC/9050 (Becton Dickinson, USA) (2007 - 2015) and BacT/ALERT (bio-Merieux, France) (2014 - 2016) automated systems. Phoenix™ 100 system (Becton Dickinson, USA) (2007 - 2014), MALDI-TOF MS (Bruker, USA) (2015 - 2016) and conventional techniques were used for the identification of isolated microorganisms. According to CLSI (2007 - 2014) and EUCAST (2015 - 2016) criteria, Kirby-Bauer disc diffusion method, Phoenix™ system, and broth microdilution were applied for antimicrobial susceptibility testing. Two five-year periods were statistically compared regarding antibiotic resistance.**

Results: **From the overall evaluated 31,380 BCs, 7,367 cultures (23.5%) were positive, excluding 503 BCs (6.4%), which were interpreted as contamination. Of 7,367 isolated microorganisms, 3,680 (50.0%) were gram-negative, 3,303 (44.8%) were gram-positive bacteria, and 384 (5.2%) were fungi. Coagulase-negative staphylococci (CoNS) were predominantly isolated (n = 2,075; 28.2%) among gram-positives. *E.coli* (n = 978; 13.3%) was the most frequently isolated gram-negative species. Between the first and the last five-year period, three genera (*Enterococcus* spp., *Acinetobacter* spp., *Streptococcus* spp.) showed significant differences when isolated, and only *Enterococcus* spp. showed increased isolation rates. In total, 90.3% of CoNS and 32% of *S. aureus* were methicillin-resistant. Only 75 strains of *Enterococcus* spp. (12.1%) were vancomycin-resistant. ESBL was detected in 40.6% of *E. coli* and 30.7% of *Klebsiella* spp. isolates. Carbapenem resistance showed a significant increase, particularly in *K. pneumoniae* (> 20%).**

Conclusions: **The findings suggest that there was a threatening condition in antimicrobial resistance rates, especially for some antimicrobials between two periods. Although antimicrobial resistance is usually associated with MRSA, carbapenem resistance, ESBL, and VRE, the problem is far beyond these definitions, consisting of not just medicine, but also commercial companies, food industry, veterinarians, and other areas.**

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Supplementary Tables

Table 1. Isolated microorganisms and their isolation rates.

Microorganisms	Numbers and Rates					
	10-year period		FP		SP	
	n	%	n	%	n	%
CoNS	2,075	28.2	739	26.4	1336	29.2
Escherichia coli	978	13.3	367	13.2	611	13.3
Klebsiella pneumoniae	659	8.9	261	9.4	398	8.6
Staphylococcus aureus	453	6.1	212	7.6	241	5.2
Pseudomonas aeruginosa	406	5.5	159	5.8	247	5.5
A. baumannii	397	5.4	168	5.9	229	5
Fungi	376	5.1	135	4.8	241	5.3
Enterococcus faecalis	346	4.7	116	4.1	230	5
Other members of *A. baumannii/calcoaceticus* complex	293	4	114	4.1	179	3.9
Enterococcus faecium	185	2.5	68	2.4	117	2.6
Enterobacter cloacae	125	1.7	54	1.9	71	1.6
Stenotrophomonas maltophilia	95	1.3	30	1.1	65	1.4
Enterococcus spp.	83	1.1	18	0.7	65	1.4
Klebsiella oxytoca	67	0.9	37	1.4	30	0.7
Acinetobacter species	62	0.8	21	0.7	41	0.9
Streptococcus viridans group	60	0.8	22	0.8	38	0.8
Serratia marcescens	54	0.7	24	0.9	30	0.6
Proteus mirabilis	51	0.7	19	0.7	32	0.7
Alcaligenes faecalis	45	0.6	12	0.4	33	0.7
Enterobacter aerogenes	43	0.6	23	0.8	20	0.4
Citrobacter species	30	0.4	8	0.3	22	0.4
Acinetobacter lwoffii	29	0.4	16	0.6	13	0.3
Morganella morganii	28	0.4	8	0.3	20	0.4
Achromobacter species	23	0.3	8	0.3	15	0.3
Streptococcus pneumoniae	22	0.3	8	0.3	14	0.3
Burkholderia cepacia complex	22	0.3	8	0.3	14	0.3
Streptococcus mitis	21	0.3	19	0.7	2	0.04
Anaerobes	20	0.3	N	N	20	0.4
Other species	319	4.33	129	4.6	190	4.16
Total	7367	100	2803	100	4564	100

CoNS - coagulase negative staphylococci, FP - First period, SP - Second period, N - None.

Table 2. Clinical distribution of isolated microorganisms.

Services	CoNS		*S. aureus*		*Enterococcus* spp.		*Streptococcus* spp.		*S. pneumoniae*		*Enterobacteriaceae*		*Acinetobacter* spp.		*Pseudomonas* spp.	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Emergency Medicine (ER)	126	6.1	38	8.5	40	6.5	5	5	1	5.3	132	6.1	78	10	18	4.1
Pediatrics	258	12.5	30	6.6	41	6.7	32	33.0	3	13.2	134	6.2	24	3.1	52	11.7
Hematology/Oncology (HO)	436	21	67	14.8	75	12.1	19	19.2	5	23.7	454	20.9	31	3.9	60	13.8
Internal Medicine (IM)	451	21.7	151	33.3	115	18.6	29	30.2	12	52.6	452	20.8	91	11.6	62	14.1
Surgical Medicine (SM)	247	11.9	60	13.2	114	18.4	7	7.7	0	0	443	20.4	125	16	88	20
Intensive Care Units (ICU)	557	26.8	107	23.6	233	37.7	5	5	1	5.3	559	25.7	432	55.4	160	36.4
Total	2,075	100	453	100	618	100	97	100	22	100	2,174	100	781	100	440	100

Table 3. Resistance rates in *Enterococcus* spp.

Antibiotics	*Enterococcus spp* (n = 622)						
	10-year period		FP		SP		p
	%	n	%	n	%	n	
AMP	49.2	267	36.7	76	46	191	0.027
GN-Syn	48.1	299	66.4	137	39	162	< 0.001
Q/D	39.4	245	N	N	59	245	NA
TEC	12.1	75	6.2	13	15	62	0.002
VAN	12.1	75	6.2	13	15	62	0.002
LZD	0.6	4	2.1	4	N	N	0.012

FP - First period, SP - Second period, AMP - ampicillin, GN-Syn - high-level gentamicin, Q/D - quinupristin-dalfopristin, TEC - teicoplanin, VAN - vancomycin, LZD - linezolid, N - None, NA - Not Applicable.