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Hospital Infection Rates and Resistance Profiles in the Neonatal Intensive Care Unit

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Abstract: Nosocomial infections in newborns have characteristics not seen in any other group of patients. Newborns treated in intensive care are a group of patients with very weak defense system prone to infections. The incidence rate of nosocomial infections in newborns is one of the highest and there are differences in this rate between developed and developing countries. In this study, it was aimed to retrospectively assess the frequency and antibiotic resistance of microorganisms isolated from patients in neonatal intensive care units. The study was conducted in neonatal intensive care unit and sent to a microbiology laboratory between 1.1.2020 and 12.12.2020. To determine the foci of infection, blood, urine sample were taken and tracheal aspirate were taken from ventilated patients. Pediatric BACTEC FX (Becton Dickinson MD, ABD) bottles were used for blood samples. 5% sheep blood agar and eosin methylene blue (EMB) medium were used for tracheal aspirate cultures. Quantitative measurements were made on the tracheal aspirate cultures. Growths with colony number>10^5 cfu/ml were considered positive growth. CDC's diagnostic criteria were used for the diagnosis of hospital-acquired pneumonia in order to exclude colonization in patients with significant growth. Infections were detected in 29 (4.7%) of the 612 newborn patients. All of them were 8 different pathogens. It consists of 15 (51.7%) male and 14 (48.3) female infants by gender. Among them, growth were detected in 6 (20.6%) blood cultures,1 (3.4%) tracheal aspirate and 22 (75.8%) urine samples. Of the microorganisms isolated, 24 (82.8%) were Gram-negative bacteria, and 5 (17.2%) were Gram-positive bacteria; The most commonly isolated pathogens among gram negative were Escherichia coli (75.9%) and 6 (27.3) of them are ESBL(Extended Spectrum Beta-Lactamases) posıtıve. Followed by *Klebsiella pneumonia* n:1 (3.4%), and n:1 (3.4%). Klebsiella oxytoca. And gram positive were Staphylococcus haemolyticus 1 (3.4%), Streptococcus acidominimus 1 (3.4%), Streptococcus mitis1 (3.4%), Streptococcus oralis 1 (3.4%) and Streptococcus vestibularis 1 (3.4%), Respectively. **Keywords:** Antibiotic, Microorganism, Neonatal Intensive Care.

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1. Introduction

Neonatal intensive care units are at high risk for developing nosocomial infections (NIs) (1). Risk factors are exposure to invasive medical devices such as mechanical ventilators and central venous catheters (CVCs) and resistant microorganisms Surveillance of NIs is a very important. Due to few reports of surveillance in neonatal units in developing countries, we planned this study. In addition, we aimed to determine the flora distribution and antibiotic resistance profile in our hospital (1, 2).

2. Material and Methods

Traceal aspırate and urıne samples are detected by conventıonal methods. Blood samples taken from the patients were placed in the BACTEC FX (Becton Dickinson MD, ABD) automated system device. The susceptibility of the samples with a growth signal was determined on the BD Phoenix TM 100 (Becton Dickinson Co Sparks MD, ABD) antibiogram device. In order to test each isolate for in vitro antimicrobial susceptibility, in accordance with the Clinical and Laboratory Standards Institute criteria (3), The standard inoculum, adjusted to 0.5 McFarland standard turbidity, was evenly distributed over the surface of Mueller Hinton agar (Oxoid, Ltd. UK). Antimicrobial discs (Oxoid, Ltd. UK) amicasin (30 µg), ceftazidime (30 µg), ceftriaxone (30 µg), chloramphenicol (30 µg), erythromycin (15 µg), gentamicin (10 µg), penicillin (10 µg), tetracycline (30 µg), cefoxitin (10 µg), etc were applied to Mueller Hinton agar plates using an automatic disk dispenser. Following an overnight incubation at 37 °C, the zone of inhibition was measured and interpreted a s susceptible, intermediate or resistant according to European Committe on Antimicrobial Susuceptibility Testig Standard Criteria (3). Our study, which was reviewed by the Institutional Health Research Ethics Review Committee of the City and Pandemi Hospital, on 21.12.2020, was ethically approved with the decision number 23-229.

2.1. Statistical Analyses

Descriptive statistics were used The Chi square. p value <0.05 was considered statistically significant.

3. Results

The most commonly isolated pathogenes were *Escherichia coli* (75.9%) and 6 (27.3) of them were ESBL (Extended Spectrum Beta-Lactamases) posıtıve in the recent year. All of ESBL positive *E.coli* are urine samples and 4 women, 2 men babies. ESBL negative samples are 16. One of the these samples is a male patient and is a tracheal aspirate sample. A blood culture sample consisting of 2 men and 1 female. Urine culture samples from 7 men and 5 women are ESBL negatıve E.coli samples. E.coli and antibiotic susceptibilty are shown in Table 1.

In antibiotic Susceptibilty profiİe of Klebsiella oxytoca 1 (%3.4) isolated from a women's baby; resistance is detected only to ampicillin and is urine sample.

In another urine sample and in the female patient K. pneumonia n:1 (3.4%) has been detected. The antibiotic resistance profile is the same as for K.oxytoca. Staphylococcus. haemolyticus n:1(3.4%) from Gram positive bacteria was isolated from the blood sample. MSKNS showed (Methicillin Sensitive Coagulase Negative Staphylococcus) profile. Another sample was blood culture n:1 (3.4%) and the isolated microorganism *Staphylococcus acidominimus*, and antibiotic sensitivity is shown in Table 2.

4. Discussion

Intensive care units take up 30% of the prevalence of infection worldwide (4). This rate emerges as a significant cause of morbidity and mortality (4). The most common types of NIs are: surgical site infections, blood stream infections, urinary tract infections (5) respiratory infections, gastroenteritis, pneumonia and meningitis and other soft tissue infections (6). Long-term hospitalization of patients, invasive interventions, low birth weight, total parenteral nutrition congenital anomalies increase the risk of infection (7) and the fact that the immune system is undeveloped in newborns also facilitates the development of health care-related infections (8). Gram-positive bacteria have been reported in neonatal nasocomial infections indeveloped countries, while Gram-negative bacteria have been reported in developing countries. (9-11). In our study, Infections were detected in 29 of the 612 newborn patients and showed that 4.7% of the patients had bacterial infections. Our study found low rates compared to some studies conducted in the world (12-17). These differences may be due to patient-related factors, equipment quality, financial resources, surveillance studies, raising awareness, and the competence of the surgical team (17). In the present study, high rate of Gram negative 24 (82.8%) bacteria were the causative agents of nosocomial infections than Gram-positives 5 (17.2%).The most frequently isolated GNB (Gram negative bacteria) E.coli 22 (75.9%) and 6 (27.3) of them are ESBL (Extended Spectrum Beta-Lactamases) posıtıve. All other pathogens were detected equally.In Our study, these isolates which are E.coli (ESBLnegative) were %66.7 rate resistant to universally recommended antibiotics (ampicillin, gentamicin) for empirical treatment. As in other studies, there was resistance to these 2 antibiotics in our results (18-21). Among Gram-negatives, *E. coli* was resistant to ceftazidime 2/16 (12.5%), amoxicillin-clavulanate 7/16 (43.8%) In the our study, high rate of Gram negative (82.8%) bacteria were the causative agents of nosocomial infections.

And this present study the most causative pathogenes is *E.coli*. As in other studies, there was resistance to these 2 antibiotics in our results. An another study, pathogenic microorganisms isolated as a hospital acquired infections had the most GNB Gram Negative Bacteria (79.8%), and the most isolated GNB was K.pneumoniae (N: 22% 29.3) (9). Mutlu et al. (22) in their study of six-year gram-negative sepsis at neonatal nasocomial infection Gram-positive microorganisms 68%, Gram-negative 32% Serratia marcescens (16.4%), Klebsiella spp as a factor of septicemia, (14.7%), Pseudomonas spp. (12%) reported, respectively. Mireya et al.(23) KNS rate 66.6%, Enterococcus 3.3% staphococcus aureus 1.1%, E. coli 13.3% Enterobacter 8.8%, Pseudomonas 4.4%, Klebsiella 2.2% were identified. Olukman et al. (24) determined hospital infections as Gram-negative infections as 44%, Gram-positive infections as 36%, and fungal infections as 20%. The most common microorganisms found as KNS, S. Aureus and Candida in a study (25) Also, in another study, the most hospital acquered infection pathogens were GNB (54.4%) and the most common pathogens were *K. pneumoniae* (19.6%) (26).

Table 1: E.coli and antibiotic susceptibilty.

	E.coli																	
	Tracheal aspirat						Blood samples						Urine					
	Male			Female			Male			Female			Male			Female		
Antibiotic	R	S	IED	R	S	IED	R	S	IED	R	S	IED	R	S	IED	R	S	IED
AMC	1						2			1			2	5		1	4	
AM	1						2				1		3	4		2	3	
SAM	1						2				1			7			5	
PTZ		1						2		1				7			5	
CAZ	1						1	1			1		2	5			5	
CRO	1						1	1			1			7			5	
FEP	1						1	1				1	2	5			5	
N			1				1	1		1			1	6			5	
AK	1						1	1			1			7			5	
LEV		1						2		1			1	6			5	
IPM-MEM- ETP		1						2			1			7			5	
CT		1			N/A			2			1			7			5	

S: Sensitive, R: Resistant, and, IED: Increased exposure to the drug CN: Gentamycin, AMC: Amoksisilin clavulanik asit, AM: Ampicillin, SAM: Ampicillin Sulbactam, Piperasilin tazobaktam: PTZ, Ceftazidime: CAZ, Ceftriakson: CRO, Cefepime: FEP, Gentamicin: CN, Amikacin: AK, Levofloxacin: LEV, Imipenem: IPM, Meropenem: MEM, Ertapenem: ETP, Colistin: CT.

Table 2: *S.acidominimus* and antibiotic susceptiblty.

	S.acidominimus					
	Blood samples					
	Male			Female		
Antibiotic	R	S	IED	R	S	IED
AMC	2			1		
AM	2				1	
SAM	2				1	
PTZ		2		1		
CAZ	1	1			1	
CRO	1	1			1	
FEP	1	1				1
CN	1	1		1		
AK	1	1			1	
LEV		2		1		
IPM-MEM- ETP		2			1	
CT		2			1	

AMC: Amoksisilin clavulanik asit, AM: Ampicillin, Penicillin: P, Oxacillin: OX, Cefoxitin: FOX, Levofloxacin: LEV, Erythromycin: E, Clindamycin: DA, Vancomycin:VA, Teicoplanin: TEC, Linezolid: LNZ. S: Sensitive, R: Resistant and IED: Increased exposure to the drug. *Streptococcus mitis* was isolated from the urine sample of a male patient. It was detected resistant to AMC and AM while was detected sensitive to DA and VA. *Streptococcus oralis* is isolated n:1(3.4%) male patients and ıt was evaluated as *contamination. Finally, Streptococcus vestibularis was isolated from the blood culture of a female patient n:1(3.4%). Antibiotic susceptibilities were determıned for AM, P, DA and TEC sensıtıves, respectively*.

Maoulain et al.(27), they reported that 79.6% of NCI was ESBL-producing GNB, and the pathogen that caused the most NCI was *K pneumoniae* (39.7%). Our results are not compatible with these literatures. But, Studies conducted in other countries are similar to our data (31, 32). Differences and similarities in our results may be due to environmental factors, host-patient and microbial factors (31, 32). Among Gram-positive bacteria, *Staphylococcus. haemolyticus n:*1 (%3.4*)* from Gram positive bacteria was isolated from the blood sample. MSKNS showed (Methicillin Sensitive Coagulase Negative Staphylococcus) profile. Another sample was blood culture n:1 (3.4%) and the isolated microorganism *Staphylococcus acidominimus*, and antibiotic sensitivity *is* Penicillin**,** Oxacillin, Cefoxitin resistance. Another sample is streptococcus mitis was isolated from urine sample and was detected resistant to Amoksisilin clavulanik asit, and Ampicillin Streptococcus vestibularis which is sensitive all of antibiotics was isolated from blood culture. The most common infections in NICUs; blood circulation infections (BSI), pneumonia and urinary tract infections (33). In our study, the highest rate of urinary system infections was found. This result may be an increased incidence of urinary tract infections in children. In addition, the fact that respiratory samples such as bronchoscopic sampling or deep tracheal aspirate are taken less than blood cultures may also be effective in these results. From another angle, the higher incidence of Gram-negative infections in our study may be due to health workers not washing their hands adequately and/or contaminated medical equipment.

5. Conclusions

Host and therapeutic risk factors for nosocomial infections should be identified with a surveillance study in the neonatal intensive care unit (NICU). The impact of the staff and the environment on the nosocomial infection rate should be evaluated and the flora of each unit should be determined. The training of the staff should be developed, the awareness of sterilization, surveillance programs should be determined regularly by the experts in order to prevent the increase and spread of resistant strains. In the detection of hospital-borne infections, epidemiological analyses should be conducted with a strong-quality microbiologist and neonatalogist. It is necessary and continuous to take rigid measures in determining the factor of infection in the hospital and taking precautions and in the formulation of antibiotics.

Limitation of the Study

Conducting this study in a pandemic hospital may be related to the limitation of the study, having only treatment procedures for the factor in the covid process.

Conflict of Interests
None
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None

Author Contributions

Celebi O; Concept, design, supervision and resources (Celebi O contribution is %60), Celebi D; Literature search, writing manuscript, analysis and interpretation (Celebi D contribution is %40).

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