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Distribution of antibiotic-resistant Staphylococcus strains among purulent-inflammatory infections

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Abstract
In 2014-2015 during the course of study of the etiological structure of the purulent-inflammatory infections from 3521 clinical materials (oral cavity, eyes, nose, pus, throat, ears, wound, skin), in 1291 cases was appeared to be caused by *Staphylococcus spp.* Infection processes caused by staphylococcus monocultures were observed in 567 cases. Based on morpho-cultural investigation was found out that 244 strains were identified as *Staphylococcus aureus* and 323 strains as *Staphylococcus epidermidis*. In 724 cases *Staphylococcus* strains were observed with various microbial associations: *S. aureus* + *S. pyogenes*, *S. aureus* + *E. coli*; *S. aureus* + *P. aeruginosa*, *S. aureus* + *Klebsiella spp.*, *S. epidermidis* + *S. pyogenes*, *S. epidermidis* + *E. coli*, *S. epidermidis* + *Klebsiella spp.*, *S. aureus* + *E. coli* + *Candida*, *S. epidermidis* + *E. coli* + *Candida*.
The impact of 21 different antibiotics from 9 groups with bactericidal and bacteriostatic activity has been studied on *Staphylococcus* strains. Freshly isolated strains were characterized with multiple resistances.

Keywords: Infection, Antibiotic, Staphylococcus

Introduction
The human organism coexists with a lot of bacteria, but despite of these the bacterial infection in many countries remains an important cause of death. Literary data, about which bacteria are prevalent among infections, is different from region and country. [1] The most common among infectious diseases staphylococcal infections are a significant problem for medical practice. Staphylococci have dominant condition among the various purulent - inflammatory processes among the soft tissues, bones, joints, lungs, pleural organs, abdominal organs. [2]
S. aureus is one of the most common etiological agents, which still remains a multiply dangerous pathogen. It cause bacteremia, osteomyelitis, urogenital and respiratory tract infections, peritonitis, skin and soft tissue infections. [3, 4, 5] Skin and soft tissue infections caused by *S. aureus* often are characterized by recurrences.
It is known that the duration of treatment depends on the type of pathogen and its nature. It should be noted that despite the dominance of *S. aureus* in a multiple purulent infection processes as a monoculture, the duration of treatment is minimal and there is no indication of the generalization of processes. [7] In any cases the essential condition of rational antibiotic therapy is identification of the taxonomic structure of pathogenic microorganisms in the development of infection and their localization. [6]
Antimicrobial resistance is a global problem caused by the uncontrolled use of antibiotics and no restrictions on the use of "reserve" antibiotics. The infections caused by resistant microorganisms are less likely to be treated, often is observed the prolonged illness and therefore medical care cost is high.
According to the latest data, despite the high prevalence of gram-negative bacteria in duration of purulent infections, staphylococcus still remains one of the most important pathogens. No less significant problem is the progressive growth and spread of antibiotics-resistant staphylococcus strains, which are hardly controlled. [9]

It is noteworthy that one of the leading positions among diseases caused by resistant microorganisms is the infections caused by *Staphylococcus aureus*. Treatment of staphylococcal infections in the modern stage is a serious problem related to the genetic mechanisms that define multiple resistances to antibiotics of these microbes. [3, 8]

The treatment is most often provides by antibiotics of the beta-lactamase group. Among them are the penicillin group (ampicillin, methicillin) and third generation of cephalosporins. The use of cephalosporins has long history. They effectively operate on a wide range of bacterial flora. [3] Long-term use of antimicrobial drugs of this class has led to a decrease in their efficacy because appeared the strains producing wide range beta-lactamases.

According to the recommendations of the International Health Organization very important systematic and coordinated monitoring of antibiotics resistances in all regions of the world. [10] In many countries, antibiotics were used not very correctly or for no purpose, that's why is recommended detailed study of antibiotics sensitivity of microorganisms.

Based on the above mentioned, the purpose of our investigation was to study the etiological structure of the purulent-inflammatory infections in 2014-2015, determine dissemination and antibiotics sensitivity of freshly isolated *Staphylococcus* strains.

Material and method

Bacteriological examination of 3521 clinical materials (samples from throat-1841, oral cavity-996, nose-445, pus-189, ear-35, wound-8, skin-3, eye-1, navel-1, ulcer-1, and maternal milk-1) isolated from patient was made according to methodological recommendations. Morphological and biochemical properties of strains were studied by standard methods using different selected media (1,5% Nutrient agar, Nutrient broth, 5% Blood agar, Manitol-salt agar, Saburo agar and etc.) and API Staph test systems. Antibiotic sensitivity was determined by Kirby Bayer's method. 21 standard antibiotic discs form 9 different groups - penicillin's, aminoglycosides, macrolides, cephalosporin's, lincomycines, sulfonamides, tetracycline's, quinolones and rifampicin's - were used. [11, 12]

Result and Discussion

Total of 3521 clinical materials were examined during 2014-2015. The largest number of samples 52,2% were from throat, 28,2% from oral cavity and 12,6% samples were from the nose.

After study of etiological structure of purulent-inflammatory infections of oral cavity, eyes, nose, throat, ears, wound, skin has been determined that in 36,6% of investigated material etiological agents were *Staphylococcus spp.*

During of various localization of purulent-inflammatory processes, infections caused with monocultures of *Staphylococcus aureus* were reported in 244 clinical samples and *Staphylococcus epidermidis* in - 323. This represents 19% and 25% of cases respectively from total number.

In cases of mono infections the largest number of *Staphylococcus* were determined in clinical samples of nose and pus. From 445 investigated materials of nose were isolated 146 and 184 strains of *S. aureus* and *S. epidermidis* (59,5% and 57%) respectivly, from 189 of pus were identified 52 strains of *S. aureus* (21%) and 108 strains of *S. epidermidis* (33.4%). Isolation rate of the rest *S. aureus* and *S. epidermidis* strains from other clinical materials wearied from 0,3% up to 7,7%.

Mixed infections were determined in 56% of cases. In cases of mixed infections *S. aureus* and *S.epidermidis* strains were isolated from 401 clinical samples of pharynx (55,3%), from 170 investigated materials of mouth (23,4%), 108 clinical samples of nose (15%) and in separate cases from pus (5%), ear (0,5%), wound (0,4%) and ulcer (0,1%). Staphylococcus was observed with various microbial associations: *S. aureus* + *S. pyogenes* - 27,8%, *S. aureus* + *E. coli* - 11,5%, *S. aureus* + *P. aeruginosa* - 0,5%, *S. aureus* + *Klebsiella spp*. - 1,6%, *S. epidermidis* + *S. pyogenes* - 2,9%, *S. epidermidis* + *E. coli* - 9,4%, *S. epidermidis* + *Klebsiella spp.* - 0,9%, *S. aureus* + *E. coli* + *Candida* - 1%, *S. epidermidis* + *E. coli* + *Candida* - 0,4%.

To study of antibiotic sensitivity of freshly isolated *Staphylococcus aureus* and *Staphylococcus epidermidis* strains have been used different 21 antibiotics with bactericidal and bacteriostatic activity: 1. Antibiotics from penicillin group - amoxicillin, ampicillin, ampisid, ampiox. 2. Cephalosporins - zinat, claforan, triaxon and fortum. 3. Aminoglycosides - gentamycin and amibak. 4. Tetracycline's - doxycycline. 5. Quinolones - ciprofloxacin, floxan, avelox, meflocid. 6. Macrolides - erythromycin, sumamed, romilar. 7. Lincosamides – dalacin. 8. Rifampicin – rifampicin. 9. Sulfonamides - Biseptol. Table 1.

Table 1: Antibiotic resistance of *S. aureus* and *S. epidermidis* strains

Antibiotic		***Staphylococcus aureus* 244 strains**			***Staphylococcus epidermidis* 323 strains**		
		resistant	**sensitive**	**resistant %**	**resistant**	**sensitive**	**resistant %**
Penicillins	Amoxicillin	85	159	34,8	135	188	41
	Ampicillin	72	172	29,5	123	200	38
	Ampisid	74	170	30,3	131	192	40
	Ampiox	93	151	38,1	105	218	32,5
Cephalosporins II generation III generation	Zinat	46	198	18,8	67	256	20,7
	Claforan	42	202	17,2	80	243	24,7
	Triaxon	51	193	21	91	232	28
	Fortum	33		13,5	89	234	27,5
Aminoglycosides II generation III generation	Gentamicin	97	147	39,7	132	191	40,8
	Amibac	93	151	38,1	115	208	35,6
Macrolides	Erytromycin	75	169	30,7	98	225	30,4
	Sumamed	101	143	41,3	114	209	35,2

	Romilar	69	175	28,2	124	199	38,3
Quinolones II generation III generation	Ciprofloxacin	31	213	12,7	46	277	14,2
	Floxan	39	205	16	44	279	13,6
	Avelox	13	231	5,3	19	304	5,8
	Meflocid	9	235	3,6	17	306	5,2
Tetacyclines	Doxycycline	82	162	33,6	175	148	54,1
Rifamicin	Rifampicin	8	236	3,2	16	307	5
Lincosamides	Dalacin	35	209	14,3	72	251	22,2
Sulfonamides	Biseptol	69	175	28,2	130	193	40,2

Resistance of isolated strains against the antibiotics from penicillin's, macrolides, aminoglycosides and tetracycline's varies from 29,5% up to 54,1%. Based on study we can see that from 29,5% to 38,1% of *S.aureus* strains were resistant to 4 different antibiotics from group of penicillin, while resistance of *S.epidermidis* isolates varies from 32,5% to 41%. Percentage rate of resistance of *S.aureus* microorganisms against erythromycin, sumamad, romilar from macrolides varies from 28,2% to 30,7% and for *S.epidermidis* straines from 30,4% to 38,3%. 39% of *S.aureus* and 38% of *S.epidermidis* strains were resistant against aminoglycosides. In the case of *S.epidermidis* the higher resistance – 54,1% was observed against doxycycline.

Comparative characterization of *S.aureus* and *S.epidermidis* strains resistance against different groups of antibiotics is shown on Fig 1.

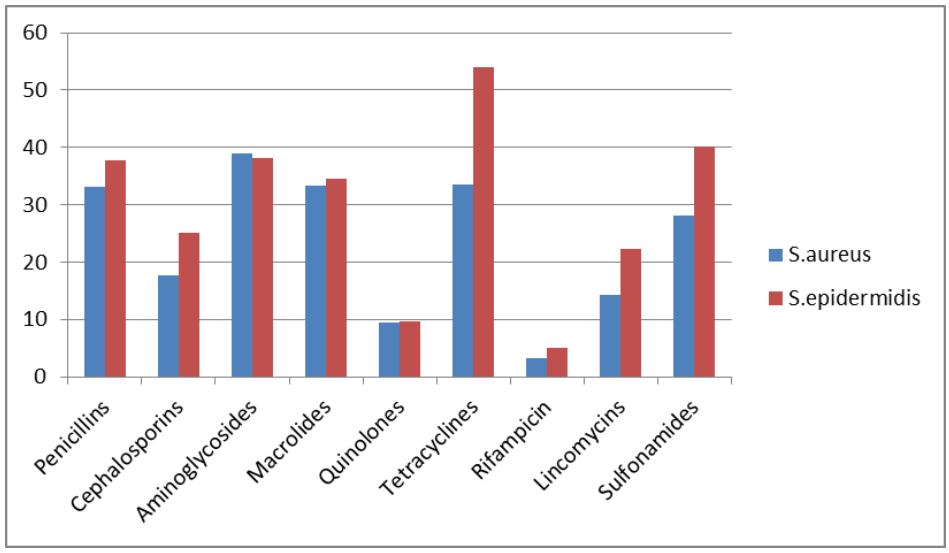

Fig. 1: Resistance of *S.aureus* and *S.epidermidis* strains against different groups of antibiotics.

Among studied antibiotics of I and II generation of quinolones and rifampicin were sensitive from 90% up to 97% strains of *S.aureus* and 90- 95% of *S.epidermidis* strains respectively.

As for biseptol from sulfanlamide's it is characterized with more high range 70% of activity towards *S.aureus* then against *S.epidermidis* strains 60%.

Conclusions

Based on study of 3521 etiological structure of purulent inflammatory infections of different clinical materials have been isolated monocultures of 567 of *Staphylococcus spp*. After investigation of were morpho-cultural properties they were divided in 2 groups: 244 strains of *Staphylococcus aureus* and 323 strains of *Staphylococcus epidermidis*. Antibiotic sensitivity of S*taphylococcus* strains has been determined against 21 antibiotics of 9 groups. These strains were characterized by multiple antibiotic resistances.

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