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Sensitivity to antimicrobial agents of Staphylococcus aureus strains isolated from upper respiratory tract in elderly people

Wrażliwość na leki szczepów *Staphylococcus aureus*
izolowanych z górnych dróg oddechowych u osób starszych

Staphylococcus aureus is one of the common human pathogens. It may colonize intermittently or persistently about 20–75% of the population. Thus *S. aureus* has a simple access to the host organism and can under predisposing conditions occasionally cause both hospital and community-acquired infections, including respiratory tract infections [1, 2, 12].

Age is one of the factors predisponding to respiratory tract infections; these diseases are more common in the elderly people due to impaired functioning of the immune system in general or local defense mechanisms in the airways. Such infections present not only a serious clinical problem but also epidemiological and social ones [9, 11].

The aim of this paper was to assess the frequency of colonization of the mucous membranes of the nose and/or throat by *S. aureus* in elderly people above 65 years of age from the Care Center. Biochemical characterization of the isolated *S. aureus* strains and their susceptibility to antimicrobial agents were also perfomed.

MATERIAL AND METHODS

Microbiological material. Throat and nasal specimens where obtained from 29 adults above 65 years old from the Care Center in Lublin. Throat specimens were obtained with sterile cotton swabs by swabbing the pharynx and tonsils, while nasal specimens – by swabbing the anterior tip of the nares.

Growth media and identification of bacterial species. The swabs were immediately streaked onto appropriate media nonselective (blood agar) or selective (Chapman agar). Plates were incubated for 24–48 h at 37°C. Identification of *S. aureus* was based on routine diagnostic methods.

Antimicrobial susceptibility testing. Susceptibility of all isolates of *S. aureus* was determined by standardized disk diffusion procedure using Mueller-Hinton agar plates, according to Clinical Laboratory Standards Institute (CLSI). Diameters of growth inhibition zones were measured after 18 h incubation at 35°C. Methicillin resistance was determined using cefoxitin disk; zone diameters were measured after 24 h incubation at 35°C.

RESULTS

It was found that *S. aureus* strains were isolated from the specimens (swabs from nose and/or throat) obtained from 17 of the 29 elderly people staying at the Care Center included in this study. The rate of colonization of the upper respiratory tract by *S. aureus* was 58.62% in the assayed population. As shown in Table 1, the rate of only nasal carriage was about 59% of the carriers, but the presence of *S. aureus* both in the nose and in the throat was found in about 35% of the carriers. Sporadically, staphylococcal strains were present only in the throat (about 6% of the carriers).

Table 1. Frequency of isolation of *S. aureus* from upper respiratory tract in the elderly people from the Care Center

Type of specimen	Number (percent) of people
Swabs from nose	10 (58.9)
Swabs from throat	1 (5.8)
Swabs from nose and throat	6 (35.3)

In order to define the biochemical phenotypes of S. aureus isolates, data from the commercial identification system – ID 32 Staph were used. According to the obtained numerical profiles, the isolates were classified as belonging to 11 biochemical phenotypes (Table 2), differing in fermentation of D-mannitol, D-mannose, lactose, D-turanose, acetoin production, resistance to novobiocin and presence of urease, arginine dihydrolase and ornithine decarboxylase. The most frequently isolated was the biochemical phenotype with numerical profile 067332610.

Table 2. Biochemical phenotypes of *S. aureus* isolates from upper respiratory tract of elderly people from the Care Center

Numerical profile according to ID 32 Staph	Number (percent) of *S. aureus* isolates
067332610	12 (32.4%)
063332610	6 (16.2%)
367332610	4 (10.8%)
267332610	4 (10.8%)
063332600	3 (8.1%)
067312610	2 (5.4%)
063332700	2 (5.4%)
063332710	1 (2.7%)
367332600	1 (2.7%)
267312610	1 (2.7%)
067332710	1 (2.7%)

Data concerning susceptibility to antimicrobial agents of S. aureus isolates are presented in Table 3. It was found that the majority of the isolates – 91.8% were resistant to penicillin and about 19% of the isolates were insensitive to tetracycline. No methicillin-resistant S. aureus (MRSA) isolates

were found, as monitored by sensitivity of the isolates to cefoxitin. All isolates were sensitive to several antibiotics (erythromycin, clindamycin, gentamicin, rifampicin, vancomycin, teicoplanin, mupirocin, chloramphenicol, fusidic acid, dalfopristin/quinupristin, linezolid, tigecycline) or chemiotherapeutics (ciprofloxacin and sulfamethoxazole/trimetoprim), recommended for routine diagnostic testing (Table 3).

Table 3. Susceptibility to antimicrobial agents of *S. aureus* isolates from upper respiratory tract of elderly people from the Care Center

Antimicrobial agent	Number (percent) of *S. aureus* isolates	
	sensitive	resistant
Penicillin	0 (0)	34 (91.8)
Cefoxitin	37 (100)	0 (0)
Tetracycline	30 (81)	7 (19)*
Erythromycin	37 (100)	0 (0)
Clindamycin	37 (100)	0 (0)
Ciprofloxacin	37 (100)	0 (0)
Vancomycin	37 (100)	0 (0)
Teicoplanin	37 (100)	0 (0)
Mupirocin	37 (100)	0 (0)
Rifampicin	37 (100)	0 (0)
Gentamicin	37 (100)	0 (0)
Sulfamethoxazole/trimethoprim	37 (100)	0 (0)
Chloramphenicol	37 (100)	0 (0)
Fusidic acid	37 (100)	0 (0)
Dalfopristin/Quinupristin	37 (100)	0 (0)
Linezolid	37 (100)	0 (0)
Tigecycline	37 (100)	0 (0)

* – Including 2 intermediate isolates

DISCUSSION

Respiratory tract infections are more common in elderly people due to age-related dysfunction of the immune response. The main etiological agents of these infections are viruses. However, the primary viral infections may injure mucous membranes and damage local defense mechanisms within airways, leading to the secondary bacterial infections, usually endogenous in origin. The ecosystem of upper respiratory tract may be regarded as the reservoir for bacterial pathogens, e. g. *Staphylococcus aureus* [2, 6, 8, 11].

In the assayed population of the elderly people attending the Care Center, the rate of colonization from the upper respiratory tract by *S. aureus* was high, reaching about 59%. However, this is in agreement with the literature data indicating that intermittent or persistent presence of *S. aureus* in the upper airways was found to be about 20–75% of the population [1, 4, 7, 10, 12].

It is known that *S. aureus* preferably colonizes a specific niche of the human body – the anterior nares [3, 6]. Likewise, according to our data, the nasal carriers comprised about 60% of the *S. aureus* carriers in airways. If the anterior nares were colonized by *S. aureus*, the bacteria may

be also present in the throat. Our data indicate that colonization by *S. aureus* of both the anterior nares and throat was observed in about 35% of the carriers. Nasal carriage seems to have a central role in epidemiology and pathogenesis of *S. aureus* infections, since it is a well documented risk factor for endogenous staphylococcal infections. The risk associated with throat carriage is largely unknown [10]. It should be noted that all of the isolates from the assayed elderly people were sensitive to mupirocin, an agent that has been shown to posses excellent efficacy for the elimination of nasal *S. aureus* carriage [3, 6, 7, 9]. Moreover, the biochemical diversity of *S. aureus* isolates from the assayed elderly people was found. This suggests that spreading of staphylococcal strains among the people attending the same Care Center is limited.

S. aureus infections, often fatal in preantibiotic era, now typically respond to a variety of antimicrobial agents besides penicillin G due to production by staphylococci with a high frequency of β-lactamases [3, 5, 8, 9]. Our data also indicate that about 90% of the staphylococcal isolates from the assayed elderly people were insensitive to penicillin G. All the isolates were classified as methicillin-susceptibile *S. aureus* (MSSA) also showing sensitivity to antibiotics and chemiotherapeutics belonging to various therapeutic groups such as: macrolides (erythromycin), aminoglicosydes (gentamicin), lincozamides (clindamycin), fluorochinolones (ciprofloxacin) and glycopeptides (vancomycin, teicoplanin); besides, the isolate were sensitive to fusidic acid, rifampicin, chloramphenicol and sulfamethoxazole/trimethoprim. The majority of the isolates (81%) were sensitive to tetracycline. All the isolates were also sensitive to new antibiotics used for treatment of serious staphylococcal infections, such as streptogramins (dalfopristin/quinupristin), oxazolidinones (linezolid) and glicylocyclines (tigecycline). The high drug sensitivity of *S. aureus* isolates from the assayed elderly people was surprising, since due to frequent respiratory tract infections these people usually receive several courses of antibiotic therapy during the year.

CONCLUSIONS

The knowledge about the actual drug sensitivity of *S. aureus* isolates from the carriers in a particular population is important to modify the rules of empiric therapy of infections, when staphylococcal etiology is probable. The high drug sensitivity of *S. aureus* isolates from the elderly people in the Care Center indicates that in the assayed population several antibiotics and chemiotherapeutics may be useful in the treatment of infections of staphylococcal etiology.

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SUMMARY

The aim of this paper was to assess the frequency of colonization of the mucous membranes of the nose and/or throat by *Staphylococcus aureus* in elderly people from the Care Center in Lublin. The rate of colonization of the upper respiratory tract by *S. aureus* was 58.62%. Nasal carriage was found in about 59% of the carriers. About 90% of the *S. aureus* isolates were insensitive to penicillin G. All the isolates were classified as methicillin-susceptibile *S. aureus* (MSSA) also showing sensitivity to: erythromycin, gentamicin, clindamycin, ciprofloxacin, vancomycin, teicoplanin, fusidic acid, rifampicin, chloramphenicol and sulfamethoxazole/trimetoprim. The majority of the isolates (81%) were sensitive to tetracycline. All the isolates were sensitive to new antibiotics, such as dalfopristin/quinupristin, linezolid and tigecycline. The high drug sensitivity of *S. aureus* isolates from the elderly people in the Care Center indicate that in the assayed population several antibiotics and chemiotherapeutics may be useful in the treatment of infections of staphylococcal etiology.

STRESZCZENIE

Celem pracy była ocena częstości występowania *S. aureus* na błonach śluzowych nosa i/lub gardła u ludzi starszych z Domu Opieki Społecznej w Lublinie. Częstość występowania *S. aureus* w górnych drogach oddechowych wynosiła 58,62%. Nosicielstwo w przedsionkach nosa występowało u około 59% nosicieli. Około 90% szczepów *S. aureus* było niewrażliwych na penicylinę G. Wszystkie szczepy zostały sklasyfikowane jako metycylino -wrażliwe *S. aureus* (MSSA), wykazujące również wrażliwość na: erytromycynę gentamycynę, klindamycynę, ciprofloksacynę, wankomycynę, teikoplaninę, kwas fusydowy, rifampicynę, chloramfenikol i sulfametoksazol/trimetoprim. Większość szczepów (81%) wykazywała wrażliwość na tetracyklinę. Wszystkie szczepy były wrażliwe na nowe antybiotyki, takie jak: dalfoprystyna/chinuprystyna, linezolid i tigecyklina. Wysoka wrażliwość na leki szczepów *S. aureus* izolowanych od osób starszych z Domu Opieki Społecznej wskazuje na to, że w badanej populacji różne antybiotyki i chemioterapeutyki mogą być używane w leczeniu infekcji gronkowcowych.