

English version: ABOUT NECESSITY OF SPLIT-SYSTEMS' FINAL DISINFECTION*

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The purpose of work consisted in comparison of microflora, isolated from the sputum of patients, with isolates, revealed in the biofilm of split-systems, installed at the place of their residence. Identity of isolates was confirmed by the spectrum of resistance to antibiotics. For Staphylococcus aureus fagotyping was additionally applied. From the sputum of patients 103 isolates of microflora during the work were selected. From the biofilm of split-systems 27 identical isolates were selected (26,2%). Consequently, results of research proved the relation between a microflora, caused a disease, and microflora from the air-conditioning systems. Therefore, split-systems in patient's apartments is a reservoir of microflora, dangerous for other habitants or visitors of this apartment. And the final disinfection of split-system, installed in an apartment, is needed after recovery of patient with the airborne diseases bacterial etiology. The researches also showed that microflora, more demanding to the cultivating temperature condition such as Streptococcus pneumoniae, Moraxella catarrhalis, Haemophilus spp. and Streptococcus agalactiae is not able to colonize split-systems. In biofilm of split-systems this microflora was absent. Staphylococcus aureus, Candida albicans, Klebsiella pneumoniae and Pseudomonas aeruginosa, vice versa, actively colonized the systems of climatization. Researches demonstrated the 82% identity of isolates, selected from the sputum of patient and from the biofilm of split-systems. Consequently, prophylactic disinfection is needed for prevention of split-systems colonization by the microflora.

Keywords: hygiene, microflora of indoor air, split-system.

Background

Due to some design features split-systems are colonized easily by pathogenic microflora [3]. In particular, at low temperatures there is a formation condensate in a heat exchanger and an entered dust in the internal block includes microorganisms, and also some suitable substrates for their multiplication.

Split-system's colonizing microflora becomes, in its turn, a cause of indoor air pollution and the risk factor of human's diseases. Therefore, carrying out of regular preventive disinfection of split-systems required. However the man, in turn, may also be a source of the microorganisms, which further colonized split-systems. In particular this applies to air conditioning systems of health care facilities and split-systems of private house there are patients with diseases transmitted by airborne droplets. In this case, after the recovery of patients should be advised of the final disinfection of air conditioning systems. The aim of this study was a confirmation of the above statement: the search of identical strains, which isolated from the sputum of patients with chronic bronchitis and pneumonia (bacterial etiology), and found in a biofilm of split systems.

Methods: During the frost-free season (May-September) of 2011-2012, sputum of patients with Chronic bronchitis (in the acute phase) and with Pneumonia from Central District Hospital (Dzhankoy City), who had split-system at home, was laboratory studied for isolation the pathogens and determination of its sensitivity to antibiotics [4, 7]. This group of respiratory system diseases has been selected for experiment because the basic mechanism of pathogen spread is aerogenic. Acute bronchitis is not considered, because it is associated mainly with the virus etiology rather than bacterial etiology [5]. Sputum were laboratory studied in the department of clinical and bacteriological diagnostic laboratory PI "Dzhankoy Central District Hospital", bacteriological department of PI " Dzhankoy linear SES

on the Pridneprovsky railway" (now renamed: the laboratory of Djankoy line department of Dnipropetrovsky separate unit PI "Laboratory Centre the railway transport of State SES Ukraine"), Dzhankoy City. Further, with the permission of patients from their home split-system, biofilm samples were taken. Taking of biofilm from the condensate tray was performed with a sterile cotton swab on a wire, which was mounted in the plug tube with 1 ml of meat-peptone broth. Delivery was made in the laboratory during two hours in cooler. With help of the dispenser, 0.1 ml of a suspension of biofilm was seeded on a Petri dish with dense nutrient mediums (yolk and salt, blood and "chocolate" agar medium, Saburo and Endo medium). Then, the incubation, isolation and identification of pure cultures were carried out [1, 11, 12, 13, 14]. The identity of the isolated strains from the sputum of patients and from the biofilm of the internal unit of a split-system, was confirmed their equal sensitivity to antibiotics. The spectrum of antibiotic resistance was a marker, because the strains, which derived from epidemiologically linked cases, have similar spectra of antibiotic resistance [10]. In order to confirm identity of Staphylococcus aureus strains in addition, a phage-typing was conducted using standard diagnostic dry staphylococcal bacteriophage manufactory by "Medgamal" (branch of State NIEM named after N. F. Gamaleya RAMS, Russia) [9]. We declare that animal studies have not been conducted, and the rights of patients in the study were taken into account in accordance with the requirements of the Helsinki Convention.

Results and discussion

During the frost-free season of 2011-2012, when the population of Crimea used the air conditioning systems, there were 426 patients with «Chronic bronchitis» (J41, J44 in ICD-10) and «Pneumonia» (J13, J15, J17.2) in the Central district hospital, Dzhankoy City. Of these patients, 102 people in the community had established a

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split-system and agreed to the sampling of the biofilm system for collecting condensate. From sputum of these patients, 103 strains were isolated; *Streptococcus pneumoniae* and *Candida albicans* were simultaneously detected in one patient's sputum. The information about the sought-for strain significantly facilitates the work of its isolation, because used the same media and methods for biofilm of split-systems located in the community of patients, 27 strains were isolated that were identical to strains, which found in the patients' sputum (Table 1). It stands to reason, the detection of 26.2% strains that are identical to the spectrum of antibiotic resistance (and, in

the case of *Staphylococcus aureus*, they are identical also by phage-typing) confirms that the source of settlement microflora split systems are the people living in those areas where split systems are installed. In consideration of the already published studies that prove the facts of preservation (multiplication) of microflora in air conditioning systems [3], as well as its role in the pollution of indoor air [15], split-systems in the premises where is the sick people should be considered as a reservoir of microorganisms and presenting the risk for other residents (visitors) of these premises.

Table 1
Pathogens from patient's sputum and from the Biofilms of the home split-systems

Pathogens	Sputum of the patients			Biofilm from the home split-systems		
	Total number	2011 year	2012 year	Total number	2011 year	2012 year
<i>Klebsiella pneumoniae</i>	8	4	4	6	3	3
<i>Streptococcus pneumoniae</i>	47	20	27	0	0	0
<i>Candida albicans</i>	10	5	5	8	4	4
<i>Streptococcus agalactiae</i>	3	1	2	0	0	0
<i>Staphylococcus aureus</i>	10	6	4	8	5	3
<i>Pseudomonas aeruginosa</i>	5	2	3	5	2	3
<i>Moraxella catarrhalis</i>	12	5	7	0	0	0
<i>Haemophilus spp.</i>	8	3	5	0	0	0
Total number	103	46	57	27	14	13

In the analysis the received data also established that during the study period respiratory pathogen most often was *Streptococcus pneumoniae*: 47 strains were isolated (45.6% of isolates). Further, on the frequency of detection the such strains were as: *Moraxella catarrhalis* (12; 11,7%), *Staphylococcus aureus* (10; 9,7%), *Candida albicans* (10; 9,7%), *Haemophilus spp.* (8, 7,8%), *Klebsiella pneumoniae* (8; 7,8%), *Pseudomonas aeruginosa* (5, 4,8%) and *Streptococcus agalactiae* (3, 2,9%). However, in biofilms of split systems, *Streptococcus pneumoniae*, *Moraxella catarrhalis*, *Haemophilus spp.* *Streptococcus agalactiae* are not isolated. We can explain this by the fact that pathogens of this *Streptococcaceae* genus have optimum growth temperature 35-37°C and the maximum possible range is from 25 to 45 ° C [8]. As interview of split systems holders shown that the majority of Crimean residents prefer to keep the temperature of the premises air in range within the 19-20°C, so this temperature is not optimal for growth of *Streptococcaceae*. *Moraxella catarrhalis* (old name - *Branchamella catarrhalis*) is also very fastidious bacteria and it is sensitive not only to the temperature range of cultivation, but the acidity of the medium [6], and the for representatives of the *Haemophilus spp.* colonization split system is not capable for the reason that required factors is necessary for growth which contained in the blood. [2]

Therefore, if in our studies we restricted by such unpretentious, low-temperature-resistant pathogens as *Staphylococcus aureus*, *Candida albicans*, *Klebsiella pneumoniae* and *Pseudomonas aeruginosa*, the result would show 82% identity of strains isolated from the sputum of the patients and the biofilms.

Conclusion

1. The source of the microflora which colonized the air conditioning system may be people, as evidenced by the isolation from biofilm of splits-systems 27 strains of *Staphylococcus aureus*, *Candida albicans*, *Klebsiella pneumoniae* and *Pseudomonas aeruginosa*, which are

identical to pathogens in the sputum of patients with chronic bronchitis and pneumonia, living in premises with split-systems.

2. Split-systems in premises where are the sick people should be considered as a reservoir of microorganisms, which is a danger to other residents or visitors of these premises.

3. Studies have shown that such a demanding temperature conditions to cultivate microorganisms as *Streptococcus pneumoniae*, *Moraxella catarrhalis*, *Haemophilus spp.* and *Streptococcus agalactiae* are not capable to colonize the split-system.

4. After recovery of the patient with the respiratory disease of bacterial etiology, the final disinfection of split-system which installed in the premises where the patient was at the time of illness is necessary to conduct.

5. Effective scheme of preventive disinfection of split-systems needs to be developed.

Литература

1. Biochimicheskaya aktivnost' rodov *Klebsiella*, *Enterobacter*, *Serratia*, *Hafnia*. – Ofiz. izd. – Char'kov. : Char'kovskaya medizinskaya akademiya poslediplomnogo obrazovaniya, 2002. – 5 s. – (Normativnyy dokument Char'kovskoy medizinskoy akademii poslediplomnogo obrazovaniya. Metodicheskie rekomendazii).
2. Vydelenie, identifikaziya i opredelenie chuvstvitel'nosti k antibiotikam *Haemophilus influenzae*. – Ofiz. izd. – Smolensk. : Nauchno-issledovatel'skiy institut antimikrobnoy chimioterapii Smolenskoy gosudarstvennoy medizinskoy akademii, 2000. – 20 s. – (Normativnyy dokument Nauchno-issledovatel'skogo instituta antimikrobnoy chimioterapii Smolenskoy gosudarstvennoy medizinskoy akademii Char'kovskoy medizinskoy akademii poslediplomnogo obrazovaniya. Metodicheskie rekomendazii).
3. Porivnyal'na charakteristika bakteriy, yaki vidleni iz kondensatu i bioplivki split-sistem kondizioneriv / S.V. Kozulya, V.Ya. Akimenko, V.G. Kuznezov ta in. // Dovkillya ta zdorov'ya. - 2012. - №2. - T.61. - S.43-46.
4. Instrukzii po opredeleniyu chuvstvitel'nosti mikroorganizmov k antibiotikam. – Ofiz. vid. – K. : M-vo ochoroni zdorov'ya Ukraini, 2002. – 61 s. – (Normativniy

- dokument Ministerstva ochoroni zdorov'ya Ukraïni, Instrukziya).
- Katilov A.V. Bronchity u detey: sovremennye predstavleniya / A.V. Katilov, D.V. Dmitriev // Dityachiy likar. – 2012. — №3,4. – S. 18-25.
 - Kolenchukova O.A. Mikrobiozenoz slizistoy obolochki nosa i rinosinuity / O.A. Kolenchukova, S.V. Smirnova, A.A. Savchenko. — Krasnoyarsk: KrasGMU, 2011. — 180 s.
 - Kolichestvennoe opredelenie bakteriy v razlichnom klinicheskom materiale. — Ofiz. vid. — K. : M-vo ochoroni zdorov'ya Ukraïni, 1996. — 52 s. — (Normativnyy dokument Ministerstva ochoroni zdorov'ya Ukraïni, Metodichni rekomendazii).
 - Malyy V.P. Streptokokkovye infekzii v praktike klinizista / V.P. Malyy // Klinicheskaya immunologiya. Allergologiya. Infektologiya. — 2012. - №4. — S. 25-33.
 - Metizillinrezistivnye Staphilococcus aureus - vzbuditeli vnutribol'nichnykh infekziy: identifikaziya i genotipirovanie. — Ofiz. izd. — M. - 2006. — 26 s. — (Normativnyy dokument Federal'noy sluzhby po nadzoru v sfere zaschity prav potrebiteley i blagopoluchiya cheloveka. Metodicheskie rekomendazii).
 - Metodicheskie ukazaniya po mikrobiologicheskoy diagnostike zabolevaniy, vzyvaemykh enterobakteriyami. — Ofiz. izd. — M. - 1984. — 134 s. — (Normativnyy dokument MZ SSSR. Metodicheskie rekomendazii).
 - Metody vyyavleniya i opredeleniya kolichestva Staphylococcus aureus : GOST 104444.2-94. — [Deystvitelen ot 1998-01-01] — Minsk : Mezhhgosudarstvennyy sovet po standartizazii, metrologii i sertifikazii, 1997. — 14 s. — (mezhhgosudarstvennyy standart SNG).
 - Metody kul'tivirovaniya mikroorganizmov : GOST 26670-91. — [Deystvitelen ot 1993-01-01] — M. : Komitet standartizazii i metrologii SSSR, 1991. — 13 s. — (gosudarstvennyy standart SSSR).
 - Mikrobiologicheskaya diagnostika zabolevaniy, vzyvaemykh psevdomonadami i drugimi nefermentiruyuschimi gramotrizatel'nymi bakteriyami. — Ofiz. izd. — K. : Kievskiy gosudarstvennyy institut usovershenstvovaniya vrachey MZ SSSR, 1988. — 24 s. — (Normativnyy dokument MZ USSR. Metodicheskie rekomendazii).
 - Opredelenie gramotrizatel'nykh potentsial'no patogennykh bakteriy - vzbuditeley vnutribol'nichnykh infekziy. — Ofiz. izd. — Moskva : Moskovskiy Oblastnoy Nauchno-Issledovatel'skiy Klinicheskiy Institut im. M.F. Vladimirovskogo. - 1987. — 35 s. — (Normativnyy dokument MONIKI im. M.F. Vladimirovskogo. Metodicheskie rekomendazii).
 - Eksperymental'noe obosnovanie vozmozhnosti perechoda mikroflory, koloniziruyushey split-sistemu, v vozdukh pomescheniya / S.V. Kozulya, V.Ya.Akimenko, V.G. Kuznezov i dr. // Gigiena naselenich misz'. — Kiïv. - 2012. — Vip. 60. — S. 64-69.

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