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Evaluation of antibiotic resistance of Acinetobacter baumannii in patients hospitalized in the Department of Internal Diseases in Lublin

The advances in medicine affect the relationships between microorganisms and increased relevance of "new" pathogens in nosocomial infections. At present, nosocomial infections are one of the most serious medical challenges in Poland and worldwide. They increase the severity of diseases as well as mortality rates; moreover, they lengthen markedly the duration of hospitalization required.

In recent years, hospital infections with *Acinetobacter* spp. have become particularly relevant (1, 3, 10). *Acinetobacter baumannii* is a bacterial strain inducing opportunistic infections in humans and an increasingly common aetiological factor of respiratory infections (pneumonia, ventilator-associated pneumonia), urinary or wound infections; it is also likely to lead to septicaemia, peritonitis, endocarditis, cerebrospinal meningitis, infections of joints, bones and bone marrow (11, 13).

The most serious therapeutic problem is associated with an increasingly high incidence of multiple antibiotic resistance infections. Numerous studies have demonstrated markedly increased antibiotic resistance rates of *Acinetobacter* spp. (1, 4, 5, 7, 10, 12). Some strains are susceptible to broad-spectrum cephalosporins, aminoglycosides and fluorochinolons. The most and sometimes the only active ones against *Acinetobacter* spp. are carbapenems and polymixins (1, 7, 12).

The aim of the present study was to evaluate the antibiotic resistance of *Acinetobacter baumannii* in patients hospitalized in the Department of Internal Diseases, Medical University of Lublin in the years 2007/2008.

MATERIAL AND METHODS

Thirty patients (15 females and 15 males) aged 70.5 ± 19.5 years were enrolled in the study. All patients underwent microbiological examinations to identify *Acinetobacter baumannii*. The retrospective analysis involved medical histories of patients and 52 antibiograms (1–6 cultures in each patient).

The figures present the structure of the study population according to causes of hospitalization (Fig. 1), clinical material in which the strains were cultures (Fig. 2) and types of invasive procedures carried out (Fig. 3).

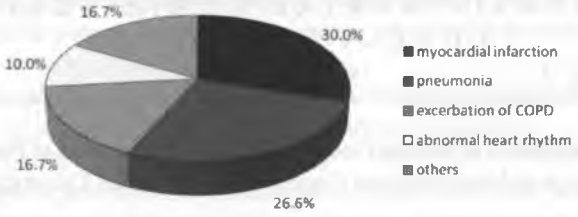

Fig. 1. Structure of the study population – causes of hospitalization (n=30)

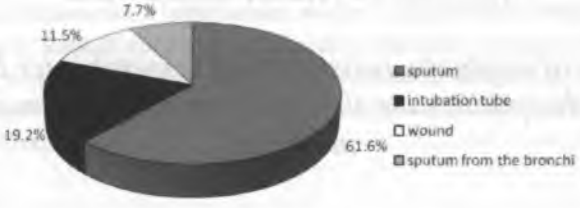

Fig. 2. Structure of the study population – clinical material examined microbiologically (n=52)

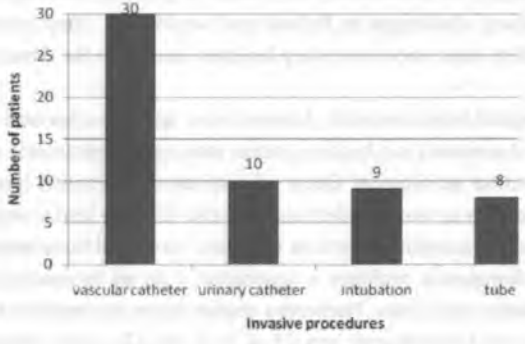

Fig. 3. Structure of the study population – patients undergoing invasive procedures (n=30)

The drug-susceptibility tests were performed using the disc diffusive method on the Mueller-Hinton medium (Oxoid) according to recommendations of the Clinical and Laboratory Standards Institute (CLSI).

The susceptibility to the following antibiotics and chemotherapeutics was determined: amoxicillin, piperacillin, ticarcillin, ampicillin with sulbactam, amoxicillin with clavulanic acid, ticarcillin with clavulanic acid, piperacillin with tazobactam, cephalothin, cefoxitin, cefuroxime, cefotaxime, ceftazidime, cefoperazone with sulbactam, cefepim, imipenem, meropenem, gentamicin, tobramycin, amikacin, netilmicin, ciprofloxacin, cotrimoxazol and colistin.

RESULTS

Amongst 52 strains of *A. baumannii*, the majority were susceptible to colistin (92.1%), netilmicin (89.5%), imipenem (86.5%), as well as meropenem (86.5%) and resistant to cephalothin (100%), cefuroxime (100%), piperacillin (90.4%), and ticarcillin (88.5%). The >80% susceptibility

was observed to only 4 antibiotics whereas the >80% resistance was found to 10 antibiotics. In 7 patients, the carbapenem resistance was observed. Fig. 4 presents antibiotic susceptibility of *A. baumannii* strains.

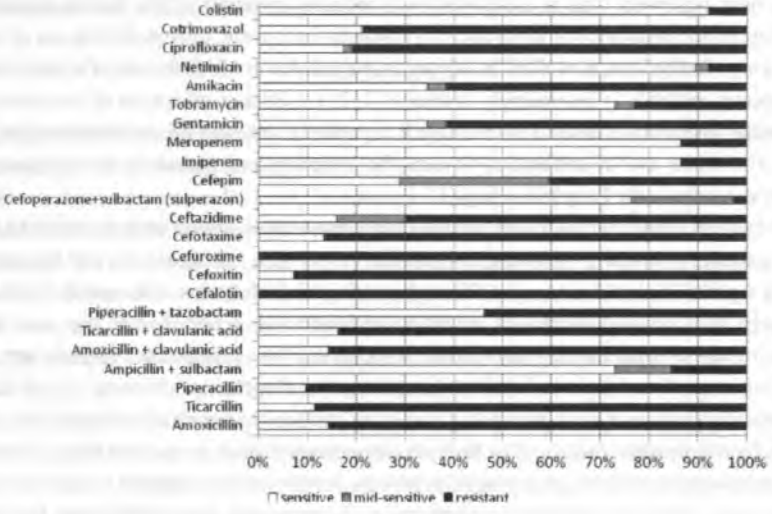

Fig. 4. Antibiotic susceptibility of *Acinetobacter baumannii* strains

The resistance to 10 or more antibiotics was found in 53.8% of *A. baumannii* strains. The mean number of antibiotics inactive to *A. baumannii* was 9. The strains of *A. baumannii* isolated from microbiological material from patients who did not undergo invasive procedures were significantly more frequently sensitive to amoxicillin, ampicillin with sulbactam, amoxicillin with clavulanic acid, cefoxitin, cefotaxime, cefoperazone with sulbactam, imipenem, meropenem, amikacin, netilmicin, ciprofloxacin compared to those isolated from patients with invasive procedures (Fig. 5).

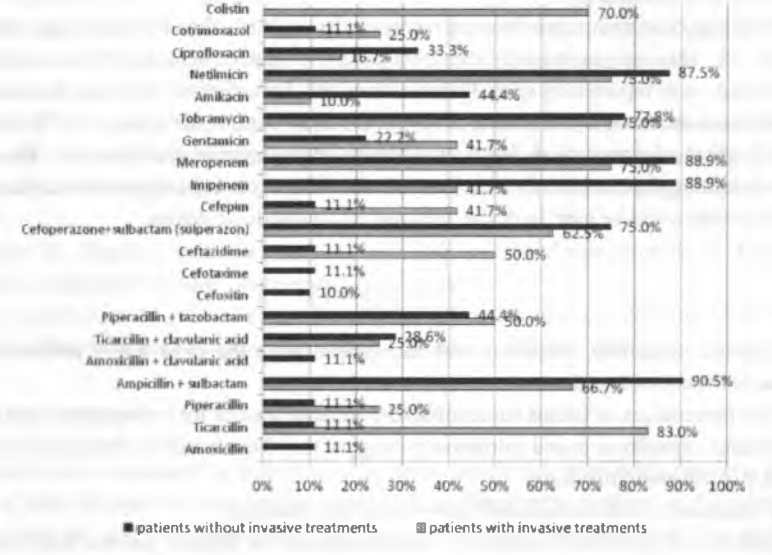

Fig. 5. Comparison of antibiotic susceptibility of *Acinetobacter baumannii* strains according to invasive procedures performed or otherwise

DISCUSSION

Within the last three decades, increased incidences of nosocomial infections with *Acinetobacter* spp. have been observed. This is associated with reduced immunity of the human population and increased antibiotic resistance of those bacteria resulting from wide, uncontrollable use of antibiotics for prevention of infections, as well as the advances in medicine in which the use of invasive diagnostic and therapeutic methods is increasingly common (1, 2, 6). Greater relevance of *Acinetobacter* spp. in nosocomial infections is related to their quick capacity to generate the resistance under antibiotic pressure. The wider use of antibiotics favours the selection and spread of *Acinetobacter* spp. of multiple resistances in the hospital setting (1).

Our findings show that 86.5% of *Acinetobacter baumannii* strains were sensitive to imipenem and meropenem. According to numerous studies (1, 7, 12), carbapenems are the most active antibiotics against *Acinetobacter* sp., although some resistant strains also occur (5, 12). Due to impressively high rates of increased antibiotic resistance of *Acinetobacter* spp. and increasing relevance of these bacteria in nosocomial infections, new therapeutic options are required. The mechanisms of resistance of *Acinetobacter* spp. to β-lactam antibiotics, i.e. production of β-lactamase, conversion of proteins binding penicillin and limited penetration through the superficial structures, have been described (1). Our findings demonstrate that *A. baumannii* strains were resistant to β-lactams, and the impact of inhibitors of hydrolytic activity of β-lactamases varied. From the three inhibitors used, sulbactam inhibited the activity of β-lactamases most effectively. Similar results were reported by other authors (4, 8). The literature data show that 75%–98% of *A. baumannii* rods produce cephalosporinases (9).

The most effective cephalosporin used was cefepim. The resistance of bacteria to aminoglycoside was most commonly related to the presence of enzymes modifying these antibiotics (1). Our results demonstrate that the highest number of strains was susceptible to netilmicin (89.5%) and tobramycin (73.1%). Interestingly, in Germany, aminoglycosides are inactive towards *A. baumannii* (12); in France (1), the strains resistant to all aminoglycoside were found whereas in Poland 85.6% of strains were sensitive to netilmicin (8).

Our findings concerning ciprofloxacin susceptibility are better than the results reported by other authors (8, 12). The analysis revealed that only 21.2% of strains were sensitive to cotrimoxazol; similar findings were reported by other Polish centres (8). According to Gospodarek et al. (8), over 74% of the strains analysed were resistant to 10 or more antibiotics; in our study – 53.8%. Considering increasingly great relevance of *A. baumannii* strains in nosocomial infections and their multiple antibiotic resistances, the data about these bacteria should be recorded and updated in various Polish centres. Such data could be used to devise the hospital antibiotic strategies.

CONCLUSIONS

1. Colistin, netilmicin, imipenem and meropenem were the most active antibiotics against *Acinetobacter baumannii* strains examined.

2. Low percentages of strains susceptible to β-lactams (except for carbapanems and ampicillin with sulbactam), ciprofloxacin and cotrimoxazol suggest that they should be eliminated from empiric therapy of *A. baumannii* infections.

3. *A. baumannii* strains examined showed multiple resistance.

4. Analysis of antibiotic resistance of microorganisms in clinical isolates from hospitalized patients enables determination of the present microbiological risks.

5. Periodic modifications of hospital antibiotic strategies are required based on monitoring of drug-resistance patters of isolated bacterial flora.

The research was conducted by using the resources of the authors.

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SUMMARY

Acinetobacter baumannii is a species of bacteria causing opportunistic infections in patients requiring a large amount of invasive procedures. Major therapeutic problem is the occurrence of strains resistant to most antibiotics used. The aim of this work was to evaluate the resistance of *Acinetobacter baumannii* to antibiotics among patients hospitalized in the Department of Internal Diseases in the years 2007/2008. The study classified sequentially 30 patients (avg. age 70.5 ±

19.5 years) hospitalized in the Department of Internal Diseases SPSK No 1 in Lublin, because of microbiological contamination with *Acinetobacter baumannii*. The study was retrospective and 52 antibiograms from documentation of patients were analysed. Among patients with microbiologically confirmed infection *Acinetobacter baumannii* the largest group were patients hospitalized because of myocardial infarction (30.0%). The antibiogram analysis shows that the most common is resistance to cephalothin (100%), cefuroxime (100%), piperacillin (90.4%) and ticarcillin (88.5%) and the most common is sensitivity to colistin (92.1%), netilmicin (89.5%), imipenem (86.5%) and meropenem (86.5%). In 7 patients there was observed resistance to carbapenems. The study demonstrated high sensitivity of *Acinetobacter baumannii* to carbapenems, but the big problem is a growing therapeutic frequency of strains resistant to these antibiotics.

Ocena oporności *Acinetobacter baumannii* na antybiotyki wśród pacjentów hospitalizowanych w Klinice Chorób Wewnętrznych w Lublinie

Acinetobacter baumannii jest gatunkiem bakterii wywołującym zakażenia oportunistyczne u pacjentów wymagających dużej ilości procedur inwazyjnych. Dużym problemem terapeutycznym jest występowanie szczepów opornych na większość stosowanych antybiotyków. Celem pracy była ocena oporności *Acinetobacter baumannii* na antybiotyki wśród pacjentów hospitalizowanych w Klinice Chorób Wewnętrznych SPSK nr 1 w Lublinie w latach 2007/2008. Do badania zakwalifikowano kolejno 30 pacjentów (śr. wieku 70,5 ± 19,5 lat) hospitalizowanych w Klinice, u których w badaniu mikrobiologicznym materiału bakteriologicznego wykryto *Acinetobacter baumannii*. Analizie retrospektywnej poddano 52 antybiogramy oraz historie chorób pacjentów. Wśród pacjentów z potwierdzonym mikrobiologicznie zakażeniem *Acinetobacter baumannii* największą grupę stanowili hospitalizowani z powodu zawału serca (30,0%). Z analizy antybiogramów wynika, że obserwuje się najczęstszą oporność na: cefalotynę (100%), cefuroksym (100%), piperacylinę (90,4%) oraz tikarcylinę (88,5%), zaś najczęstszą wrażliwość na kolestynę (92,1%), netylmycynę (89,5%), imipenem (86,5%) i meropenem (86,5%). U 7 pacjentów obserwowano oporność na karbapenemy. W badaniu wykazano wysoką wrażliwość *Acinetobacter baumannii* na karbapenemy, jednakże dużym problemem terapeutycznym jest coraz częstsze występowanie szczepów opornych na te antybiotyki.