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Methicillin-Resistant *Staphylococcus aureus* - Situation in the Children's University Hospital in Banská Bystrica in 2016-2018

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Abstract

Methicillin-Resistant *Staphylococcus Aureus* (MRSA) belongs to a group of bacteria forming the ESCAPE group (acronym of bacteria that cause severe hospital infection- *Enterococcus faecium, Staphylococcus aureus, Clostridium difficile, Acinetobacter baumannii, Pseudomonas aeruginosa, Enterobacteriaceae*). The Slovak republic is in the red zone of staphylococcal resistance (red zone 25-50%), the average incidence of MRSA in Slovak republic is 29% in 2017. Neighboring countries have a percentage of resistance up to 25%. MRSA is becoming a growing medical problem. Population aging, immunosuppressive therapy, long-term venous inputs, implants, high consumption of antibiotics in veterinary and human medicine are factors that increase its incidence. The article deals with MRSA's situation at Children Clinic in Banská Bystrica from 2016-2018.

Keywords: MRSA; New Generation of Antibiotics; Resistance Against Beta-Lactam Antibiotics

Introduction

MRSA is a gram positive bacterium whose mechanism of resistance is based on the synthesis of PBP 2 (peniciline binding protein 2), a beta-lactam ring inactivating protein. MRSA is not more virulent than other strains of Stafylococcus aureus [1,2]. We distinguish between C-MRSA and N-MRSA. C-MRSA is a community strain, well treatable with common non-betalactam antibiotics. N-MRSA is a nosocomial strain that causes nosocomial infections ranging from colonization to fatal multiorgan failure. It has a high affinity for the skin and wet mucous membranes, long durability in textiles (4-21 days), good sensitivity to disinfectants, and is resistant to all beta-lactam antibiotics.

Spread of Bacteria

The source of bacteria transmission is mainly the hands of medical staff (artificial nails, watches, rings) and medical devices (manometer, stethoscope, ECG electrodes). The basic principle of preventing the spread of MRSA are anti-epidemic measures in hospital departments. Within the Slovak Republic there is expert guidance of the Ministry of Health of the Slovak Republic for the diagnosis and anti-epidemic measures in the presence of resistant bacteria [1,3]. In hospitals, which are educational centers, it is also necessary to educate interns (medical students, nurses), who are in contact with patients [4].

MRSA in the European Union (EU) and the Slovak Republic

The European Center for Disease Prevention and Control (ECDC) in its annual report for 2017 published data on the number

of MRSA invasive diseases in the EU, which represented 16.9% of the total number of staphylococcal infections. The Slovak Republic is in the red zone of resistance (25-50%), the percentage of MRSA was 29.1%. The Czech Republic is in the orange zone (10-25%), with an incidence of 13.2% (Figure 1). The situation in the EU is stable and the incidence of resistance is on a downward trend. It is rising slightly in the Slovak Republic Source (Figure 2) [5].

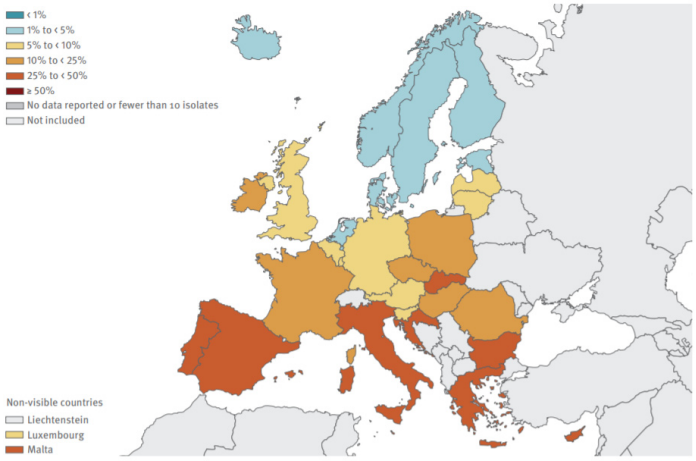


Figure 1: Percentage of MRSA resistance in the EU in 2017.

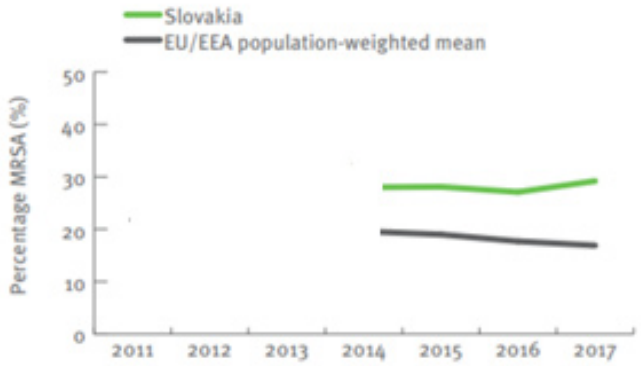


Figure 2: Development of MRSA resistance in the Slovak Republic in comparison with the EU [5].

Risk Patients and Risk Departments

Risk patients with severe course of MRSA infection are immunocompromised patients, with chronic diseases, with vascular access, elderly patients living in collective facilities. The risk of *MRSA* occurrence depends on the type of department (Table 1) [1].

1- High Risk: burn centers, transplantation units, cardiosurgical centers, neurosurgery, orthopedics, traumatology, special centers with a wide area of focus (high risk of developing serious clinical forms)
2 - Moderate Risk: general surgery, urology, neonatology, gynecology and obstetrics, dermatology, ORL
3 - Low Risk: standard departments: internal medicine, neurology, **paediatrics**
4 - Special Risk: psychiatry, geriatrics, orphanage, retirement homes- low risk of developing serious clinical forms

Table 1: Risk Departments for MRSA [1].

MRSA Treatment

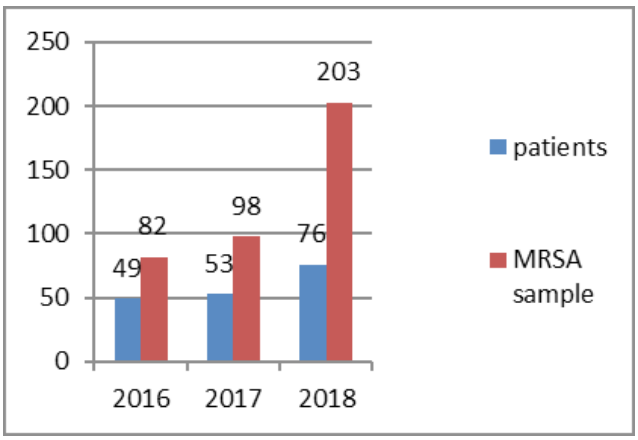
To eliminate the MRSA carrier we use topical antiseptics (Table 2). Decolonization lasts 7 days, after two days of discontinuation of treatment, we control swabs, if MRSA persists change the antiseptic. Antibiotic therapy is intended for the treatment of systemic infections. Among antibiotics we use non-balactam antibiotics (macrolides, tetracyclines, co-trimoxazole) for the treatment of community C-MRSA. Polyresistant strains are treated with glycopeptides (vancomycin), for resistance to glycopeptides we choose oxazolidinones (linezolid). 5th generation cephalosporins are reserved for the treatment of severe MRSA infections. A new generation of antibiotics is coming to our market. Group called BLA inhibitors (cephalosporins of higher generations and carbapenems with beta-lactamase inhibitors), other anti GNB antibiotics (anti gram negative bacteria) derived from fluoroquinolones- delafloxacin, aminoglycosides-plasmomycin, evaracycline, the last group being glycopeptide antibiotics. New antibiotics are not intended for pediatric patients [1,6,7]. One of the options for the treatment of serious infections is active immunization in the future - vaccination against MRSA and prevention of infection. Several clinical trials are currently in progress to reduce the incidence and severity of infections [8,9].

Mupirocin (Bactroban ointment, Bactroban nasal)
Chlorohexidine (solutions)
Prontoderm - washing solution and gel
Braunol 10%
Prontosan - for wounds

Table 2: Topical Antiseptics [1].

Situation in the Children's University Hospital in Banská Bystrica From 2016-2018

In cooperation with the Microbiology Department of the University Hospital and the F.D. Roosevelt in Banská Bystrica, we created an overview of the situation of MRSA in the Children's University Hospital in Banská Bystrica. From 2016-2018, data was analyzed directly from clinical materials - tonsil (TT), nose (TN), rectum (TR), percutaneous endocospical gastrostomy (PEG), tracheostomy (TCHS), skin, wound, sputum and blood culture. The results (Figures 1-2) point to an upward trend in MRSA in the DFN BB.



Graph 1: Comparison of the number of MRSA patients in DFN BB with a positive MRSA sample (TT, TN, TR, sputum, HK, skin, TCHS, PEG).

Comparison of the number of patients per year to the number of positive MRSA cultures - TT, TN, TR, skin, TCHS, PEG, HK. One patient may have multiple positive MRSA culture samples several times a year (TT, TN, skin sterile - e.g. in carriers). This explains the difference between the number of patients and the number of positive MRSA samples.

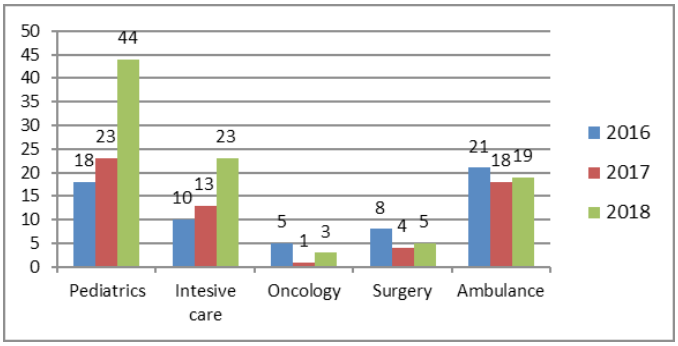
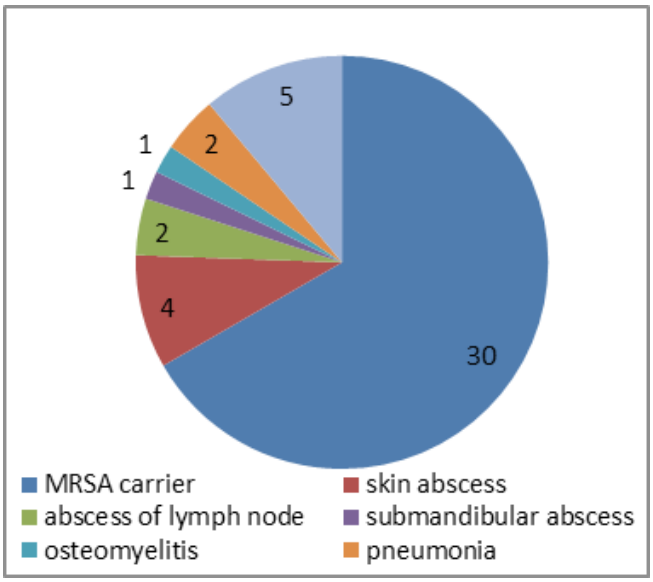


Figure 3: Number of MRSA patients cases in individual departments of DFN 2016-2018.

Number of positive MRSA cases per department (2016-2018). One patient per ward is considered as 1 case. If the patient has been transferred to another hospital department (eg from Intensive care to Pediatrics), it is counted as another case for the next department. Number of completed hospitalizations in DFN in BB (Table 3).

2016- 5446 completed hospitalizations in Children Clinic
2017- 5401 completed hospitalizations in Children Clinic
2018 - 5483 completed hospitalizations in Children Clinic

Table 3: Number of completed hospitalizations in DFN in BB.



Graph 2: MRSA patients in Pediatric Clinic in 2018, number of patients 45, 40 found data, number of patients hospitalized in Pediatric Clinic in 2018- 2455.

- 30 patients with positive MRSA sample, without clinical manifestation - carrier
- 21 chronic patients, of whom 8 are placed in orphanages
- Chronic MRSA patients- neurological patients (patients with cerebral palsy, with chromosomal aberrations, spinal cord damage).

Conclusion

The number of MRSA patients in DFN BB is increasing, with asymptomatic patient carriers prevailing. The number of completed hospitalizations in 2016-2018 is approximately the same (Table 3). According to the data processed in 2016-2018, the number of MRSA positive patients in DFN BB increased by 55% in 2018 compared to 2016. The number of positively examined MRSA samples increased by 147% in 2018 compared to 2016 (Figure 1).

This result is explained by repeated examination of samples in the same patients and possible positivity of multiple samples (sample from nose and tonsils).

The highest number of MRSA cases is at Pediatric department. The percentage of MRSA symptomatic patients was 18.75% in 2016, 30% in 2017 and 25% in 2018. This number is explained by the highest number of completed hospitalizations in DFN BB and by examination of culture samples (there is a marked lower number of culture microbiological examinations in surgery department).

In a deeper analysis of diagnoses at Pediatric Department in 2018, 40 MRSA positive patients were found, 30 were carriers (75%). Symptomatic patients [10] most commonly had skin abscess [8], abscess of lymph node [6], submandibular abscess [1], osteomyelitis [1] and pneumonia [6].

At the Department of Pediatric Hematology and Oncology, the incidence of MRSA infection in 2018 was associated with severe sepsis [6] and pneumonia [1], with no carriers present in this department. This compartment is most at risk for seriously occurring MRSA infections.

Patients at the Clinic of Pediatric Surgery were hospitalized for abscesses in the gluteal region and the carriers were not present in this department in 2018 (respectively they were not cultivated).

There were 2 groups of MRSA patients at the Department of Pediatric Anaesthesiology and Intensive Medicine. The first group consisted of long-term hospitalized patients in whom the MRSA strain developed during antibiotic treatment for severe conditions. The second group consisted mainly of neurological patients hospitalized for respiratory insufficiency (MRSA carriers, MRSA was not the cause of the disease).

Discussion

Considering the large catchment area, the follow-up care of patients initially hospitalized and treated for severe conditions at Department of Pediatric Anaesthesiology and Intensive Medicine, the care of chronic patients, the incidence of MRSA at Pediatric Department is higher compared to other pediatric department in central Slovakia. For the spectrum of patients we rank among departments with a higher risk of MRSA and there is also a higher risk for seriously occurring MRSA infections (Table 4).

Department	2016 CH	2016 MRSA	2017 CH	2017 MRSA	2018 CH	2018 MRSA
PD BB	2456	16	2544	23	2455	40
PD Brezno	1684	23	1432	13	1480	10
PD Zvolen	1110	2	1084	3	1118	9
PD Lucenec	1169	1	1210	2	1204	7

Table 4: shows the number of completed hospitalizations (CH) and the number of MRSA patients in the pediatric deparment (PD) in Banská Bystrica (BB), Brezno and Zvolen in 2016-2018.

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