OPEN ACCESS

Research Article

MRSA distribution and epidemiological procedures evaluation at two hospitals in Northern Poland

MRSA-Verteilung und epidemiologische Evaluation in zwei Hospitälern in Nordpolen

Abstract

In the present study we have analyzed the impact of modified MRSA screening of carriers and patients on epidemiological situation of MRSA during 2008–2010, comparing two regional hospitals with similar bed numbers and similar ward profiles in Northern Poland. In 2008 the proportion of MRSA to all *S. aureus* isolates was 14.4% resp. 6.0%, in 2009 8.3% resp. 4.7% and in 2010 6.5% in both hospitals. Independent of the different prevention and intervention strategy in both hospitals the different MRSA incidence seems to be due to regional epidemic settings

Keywords: MRSA, screening, incidence, regional comparison

Zusammenfassung

In der Studie wurde der Einfluss eines modifizierten MRSA-Screenings bei Trägern und Patienten auf die epidemiologische Situation von MRSA in zwei ähnlichen regionalen Krankenhäusern in Nordpolen im Zeitraum 2008–2010 analysiert. Unabhängig von der unterschiedlichen Strategie der Prävention und Intervention in beiden Krankenhäusern dürfte die unterschiedliche MRSA-Inzidenz regional begründet sein.

Schlüsselwörter: MRSA, Screening, Inzidenz, regionaler Vergleich

Krystyna Paszko[1]
Ewa Michnowska[1]
Julianna Kurlenda[2]
Mariusz Grinholc[3]
Joanna Nakonieczna[3]
Krzysztof Piotr Bielawski[3]

1 Department of Clinical Bacteriology, Specialist Hospital, Gdansk, Poland

2 Department of Clinical Bacteriology, Regional Hospital, Koszalin, Poland

3 Intercollegiate Faculty of Biotechnology, University of Gdansk and Medical University of Gdansk, Department of Biotechnology, Laboratory of Molecular Diagnostics, Gdansk, Poland

Introduction

Methicillin resistant *Staphylococcus aureus* (MRSA) is one of the most common pathogens responsible for hospital infections and, as recently discovered, also for community acquired infections. It can cause a broad spectrum of infections through local invasion, toxin mediated diseases to generalized infections. *S. aureus* is a bacterium commonly present in the human population and constant or part time carrier frequency in the nasal vestibule is estimated at 30–60% [6], [8], [19], [26]. Therapeutic problems are mainly caused by infections with strains, which are resistant not only to methicillin (methicillin-resistant *S. aureus*, MRSA) and in consequence to all β-lactam antibiotics but also to many other group of antimicrobial therapeutics. The presence of this pathogen enables its local distribution e.g. within a hospital ward and/or between hospital wards (hospital or healthcare acquired) HA-MRSA [2], [12], [13], [22], [23]. When such a strain carries genes responsible for the resistance to many antibiotics, as in the in case of HA-MRSA strains [2], [7], [12], [13], [22], [23]; then it becomes a great problem both, therapeutically – due to the limited number of antibiotics available, as well as economically – due to the necessity of expensive drugs and the prolonged time spent in the hospital [4], [5], [9], [10], [15], [21], [25]. The increase of costs is also a result of special procedure initiations needed for controlling the wide-spread of the pathogen, such as hygienic and isolation procedures, identifying the carrier and, next, its eradication [1], [13], [17]. In some countries MRSA can constitute up to 80% of all *S. aureus* isolates in hospitals [14]. In some Polish hospitals the percentage of MRSA strains reached up to ~60% [20]. The frequency of bacteremia of this etiology, according to research carried out in the years 1999–2000 in Europe, depending on

the country ranged from 44.4% (Greece) to 0.6% (Denmark and the Netherlands) [24]. According to the research of SENTRY carried out in the years 1997–1999 in USA, Canada, Latin America, and Western Pacific, the percentage of infection in these areas was 25.3; 19.2; 20.6 and 21.6, respectively [3]. In our study we have analyzed the impact of modified procedures on epidemiological situation of MRSA during the last three years comparing two similar hospitals in Northern Poland.

Material and methods

A three-year-lasting period (2008–2010) was analyzed. Only the first isolate from one patient and no duplicate were taken into account.

Hospital no. 1

Gdansk is the city that lies on the southern edge of Gdansk Bay (of the Baltic Sea), in a conurbation with the city of Gdynia, spa town of Sopot, and suburban communities, which together form a metropolitan area called the Tricity (*Trójmiasto*), with a population of over 800,000. Gdansk itself has a population of 455,830 (June 2010), making it the largest city in the Pomerania region of Northern Poland.

The 608-bed regional hospital contains three internal departments, cardiology, neurology, pediatric ward, surgery, orthopedic, ICU (adult), ICU neonatal, obstetrics and gynecology, neonatology, laryngology, ophthalmic ward and dialysis unit. The yearly admittance rate and average hospitalization time are presented in Table 1 and Table 2. Population of the citizens with access to this hospital is estimated on the level of 205,000.

Bacteriology lab has an access to the analytical software WHONET (WHO) and VITEK (BioMerieux, France).

The modified epidemiological procedure concerning MRSA carriers and patients (Procedure 1) has been implemented within the hospital.

Procedure 1 is characterized by the following criteria:

- Epidemiological procedure concerning initial MRSA, VISA or VRSA isolation.
- Patient suspected of being infected (colonized) with MRSA, should be placed in a separate room, may be provided with other patients who have had the presence of a strain.
- The patients prescribed to eradication treatment should not be cohorted.
- The epidemiological investigation is being performed to determine the origin of the strain.
- In the case of hospital-acquired infections, the high-risk patients are being screened with microbiological tests (nasal-throat, respiratory tract and rectal isolations).
- The employed medical staff is trained over the prophylaxis of MRSA, VISA and VRSA infections.
- The verification of the established epidemiological procedures is performed.

Hospital no. 2

Koszalin is the largest city of Middle Pomerania in northwestern Poland, possess a county-status city and is a capital of Koszalin County of West Pomeranian Voivodeship since 1999. Previously, it was a capital of Koszalin Voivodeship (1950–1998). Population of the citizens with access to this hospital is estimated on the level of 650,000 and Koszalin itself has a population of 107,217 (2009).

The 609-bed regional hospital contains two internal wards, cardiology, neurology, oncology, infectious diseases ward, pediatric, children surgery, general surgery, orthopedic, ICU (adult), ICU neonatal, obstetrics and gynecology, neonatology, laryngology, ophthalmic ward, dermatology and dialysis unit. The hospital characteristics have been presented in Table 3 and Table 4.

Bacteriology lab has an access to the analytical software Marcel.

The modified epidemiological procedure concerning MRSA carriers and patients (Procedure 2) has been employed implemented in the hospital.

Procedure 2 is characterized by the following criteria:

- Procedure of treatment of patients suspected of MRSA infection, infected (colonized) with MRSA (Methicillin Resistant *Staphylococcus aureus*), VRSA (Vancomycin Resistant *Staphylococcus aureus*), VRE (Vancomycin Resistant Enterococci) refers to medical staff, supporting staff, staff of hospital hygiene
- Patient suspected of being infected (colonized) with MRSA should be placed in a separate room, may be provided with other patients who have had the presence of a strain
- Room equipped with items and equipment as the standard isolation of infections spreading through direct contact
  - indicated the use of single sheets
  - in the case of reusable application, one should proceed as in terms of dirty sheets
- Room doors must be closed
- Medical and hospital hygiene staff are informed on the reason of isolation
- One entering the room should put on
  - disposable protective – apron, shoe pads, cap on head
  - disposable non-sterile gloves for nursing activities, sterile for aseptic operations
  - surgical mask in case of carrying of MRSA/VRSA/VRE in patient's airway
  - before leaving the room take off personal protective equipment and place in red bag
  - before performing the steps, in the course if necessary, and upon completion, the procedure for hygienic hand-washing applies
- Mandatory reporting by consultants (visiting family) to a designated nurse to obtain information about safety precautions

Table 1: The characteristics of the hospital in Gdansk

Year	No. of beds	No. of hospitali-zations	% patients' beds occupation	Average hospitali-zation time (days)	No. of microbio-logical specimens	No. of microbiological specimens/ 100 patients	No. of microbiological specimens/ 1000 persondays of hospitalization
2008	608	24,990	75.5	6.7	25,471	101.9	151.6
2009	608	25,533	76.3	6.6	28,258	110.7	166.9
2010	608	25,089	75.7	6.7	30,791	122.7	183.4

Table 2: Rate of MRSA isolation (hospital Gdansk)

Year	*S.aureus* (no.)	MRSA (no.)	MRSA/*S.aureus* (%)
2008	478	69*	14.4
2009	434	36	8.3
2010	663	43	6.5

* internal ward: epidemic origin – 4 infected patients (1 patient admitted with infection, positive blood culture), 1 carrier

Table 3: The characteristics of the hospital in Koszalin

Year	No. of beds	No. of hospitali-zations	% patients' beds occupation	Average hospitali-zation time (days)	No. of microbio-logical specimens	No. of microbiological specimens/ 100 patients	No. of microbiological specimens/ 1000 persondays of hospitalization
2008	641	29,686	4.9	62.3	8,762	29.5	59.9
2009	615	34,134	4.8	68.2	10,966	32.1	76.3
2010	571	30,603	4.6	67.1	13,942	45.6	98.2

Table 4: Rate of MRSA isolation (hospital Koszalin)

Year	*S.aureus** (no.)	MRSA** (no.)	MRSA*** (no.)	MRSA Carriers (no.)	MRSA/*S.aureus* (%)
2008	533	3	22	9****	6
2009	321	4	7	4	4.7
2010	307	0	11	9	6.5

* *S.aureus* from clinically significant materials
** MRSA – hospital infections
*** MRSA – patients admitted to hospital with infection
**** neurology ward: epidemic origin – 4 infected patients (1 patient admitted with infection), carriers – 7 patients, 2 employed staff

  - avoidance of unnecessary traffic in the hall of the isolation ward
  - restriction of movements of the patient in the ward and outside – full information about the precautionary measures
- Wasted disposable equipment, dressings, etc. are subject to proceedings according to the instruction of medical waste
- Reusable equipment is subject to disinfection processes, cleaning and sterilization
- Dealing with surfaces contaminated with biological material in accordance with the procedure for the safety and handling of infectious material
- Hygienic treatment of patient:
  - the entire body must be washed daily with an antiseptic for this purpose, hair shampoo 2x a week
  - the patient's bedding and linen change every day, following the steps "on-bed" bedside management of patient
- Cleaning the room twice a day and depending on the needs

- In order to identify carriers and patients infected with MRSA/VRSA material for microbiological examination should be collected from the nasal vestibule or perineum, or groin, or areas of the affected skin; material for a directed search towards VRE identification should be sampled from the anal area (or a stool sample) or the perineum, lesions of the damaged skin or the cathetered patient's urine sample
- Patients, who have had contact with microbiologically diagnosed MRSA/VRSA/VRE infected patient or MRSA/VRSA/VRE carrier, should be cohorted
- If a patient is diagnosed as MRSA/VRSA/VRE carrier and if allowed by the clinical condition, the patient should be discharged with recommendations for further treatment aimed at eliminating the carrier state-control swabs should be taken for at least 5 days after the procedure eliminating carrier state; it is advisable to obtain a 3-time negative results
- The re-taking of the patient to the hospital or taking a patient previously hospitalized in other wards/hospitals, where endemic or epidemic presence of MRSA/VRSA/VRE was recorded, it is advisable to carry out directed microbial diagnostics; until the results are obtained, strict adherence to the principles of insulation of directly transmitted infections must be applied
- Staff colonized with MRSA/VRSA/VRE should be removed from contact with patients, until elimination of the carrier state; before taking the job a microbiological control of the MRSA/VRSA/VRE carrier state should be performed, especially in the personnel previously employed in hospitals where the MRSA/VRSA/VRE were registered.

Results

According to comparative analysis performed for two regional hospitals of Northern Poland with similar bed numbers (608 vs. 609) and similar ward profiles, the percentage of MRSA distribution was different. In 2008 at hospital no. 1 the rate of MRSA to all *S. aureus* isolates was 14.4% and at hospital no. 2 the same rate was 6.0%. In 2009 these rates were 8.3% and 4.7%, respectively. However, in 2010, the rate was similar for the two described hospitals (Table 2 and Table 4). The differences concern also the number of hospitalized patients, hospitalization time and number of microbiological tests performed (Table 1 and Table 3). At hospital no. 1 the number of hospitalized patients was approx. 25,000, the hospitalization time was 6.6–6.7 days with percentage of patients' beds occupation of approx. 75%. At hospital no. 2 the number of hospitalized patients was higher – ca. 31,000, nevertheless the average hospitalization time was shorter and was calculated as 4.6–4.9 days with lower percentage of patients' beds occupation (62.3–68.2%). The high difference concerns also the number of microbiological specimens. At hospital no. 1, the number of specimens/100 patients was as follows: in 2008 – 101.9, in 2009 – 110.7 and in 2010 – 122.7. At hospital no. 2 much smaller number of specimens/100 patients was performed in each year: 29.51, 32.1 and 45.6, respectively.

Discussion

In the last decade in Poland, the monitoring of MRSA infections and carriers has been improved [11], [16]. Previously some health-associated centers introduced the survey, and epidemiological procedures concerning MRSA carriers and patients [11], [13], [18]. Currently, many hospitals in Poland are involved within the European project EARS-Net (http://ecdc.europa.eu/en/activities/surveillance/EARS-Net/), what enables in future the unification of procedures and surveillance methods. Nowadays, each medical center forms its own procedures on the basis of obtained results from epidemiological investigations. Both of described hospitals have already been involved within the above-mentioned project. It is clearly visible that the comparison of even very similar hospitals is quite difficult. Twice more isolations of MRSA in 2008 at hospital no. 1 could result from regional epidemic settings. In that time one outbreak in internal was noticed (4 infected patients, 1 carrier). Relatively, in hospital no. 2 in the same year in spite of a lower number of specimens send for bacteriological analysis, there were more isolations of *S. aureus* (533 vs. 478) and smaller number of isolation of MRSA with one outbreak in neurology ward (4 infected patients and 9 carriers). Though the percentage of MRSA in 2010 year was slightly higher (6.5%), we have observed the decrease of MRSA hospital-acquired infections from 3 and 4 in 2008–2009 to 0 in 2010. It is interesting that in both hospitals the number of specimens send to bacteriology lab consequently increased whereas the frequency of MRSA isolations decreased. In our opinion, it results from effective and properly used procedures of MRSA surveillance. This opinion could be supported by results from EARS-Net report where overall in Poland MRSA isolation frequency in 2009 is 20% (http://ecdc.europa.eu/en/activities/surveillance/EARS-Net/).

Notes

Conflicts of interest

The authors declare that they have no competing interests.

References

1. Coia JE, Duckworth GJ, Edwards DI, Farrington M, Fry C, Humphreys H, Mallaghan C, Tucker DR; Joint Working Party of the British Society of Antimicrobial Chemotherapy; Hospital Infection Society; Infection Control Nurses Association. Guidelines for the control and prevention of meticillin-resistant Staphylococcus aureus (MRSA) in healthcare facilities. J Hosp Infect. 2006;63 (Suppl 1):S1-44

2. Conceição T, Aires-de-Sousa M, Füzi M, Tóth A, Pászti J, Ungvári E, van Leeuwen WB, van Belkum A, Grundmann H, de Lencastre H. Replacement of methicillin-resistant Staphylococcus aureus clones in Hungary over time: a 10-year surveillance study. Clin Microbiol Infect. 2007;13(10):971-9. DOI: 10.1111/j.1469-0691.2007.01794.x

3. Diekema DJ, Pfaller MA, Schmitz FJ, Smayevsky J, Bell J, Jones RN, Beach M; SENTRY Partcipants Group. Survey of infections due to Staphylococcus species: frequency of occurrence and antimicrobial susceptibility of isolates collected in the United States, Canada, Latin America, Europe, and the Western Pacific region for the SENTRY Antimicrobial Surveillance Program, 1997–1999. Clin Infect Dis. 2001;32 (Suppl 2):S114-32. DOI: 10.1086/320184

4. Dzwonkowska J, Kurlenda J, Baczkowski B, Mazurkiewicz S, Uzunov I, Ziólkowski W, Markowicz A. The effect of antibiotic therapy on the incidence of Staphylococcus aureus infections in orthopaedic patients. Ortop Traumatol Rehabil. 2007;9(5):532-47.

5. Finch R. Gram-positive infections: lessons learnt and novel solutions. Clin Microbiol Infect. 2006;12:3-8. DOI: 10.1111/j.1469-0691.2006.01624.x

6. Graham PL 3rd, Lin SX, Larson EL. A U.S. population-based survey of Staphylococcus aureus colonization. Ann Intern Med. 2006;144(5):318-25.

7. Huang YH, Tseng SP, Hu JM, Tsai JC, Hsueh PR, Teng LJ. Clonal spread of SCCmec type IV methicillin-resistant Staphylococcus aureus between community and hospital. Clin Microbiol Infect. 2007;13(7):717-24. DOI: 10.1111/j.1469-0691.2007.01718.x

8. Kalmeijer MD, van Nieuwland-Bollen E, Bogaers-Hofman D, de Baere GA. Nasal carriage of Staphylococcus aureus is a major risk factor for surgical-site infections in orthopedic surgery. Infect Control Hosp Epidemiol. 2000;21(5):319-23. DOI: 10.1086/501763

9. Karchmer AW. From theory to practice: resistance in Staphylococcus aureus and new treatments. Clin Microbiol Infect. 2006;12:15-21. DOI: 10.1111/j.1469-0691.2006.01626.x

10. Karchmer TB, Durbin LJ, Simonton BM, Farr BM. Cost-effectiveness of active surveillance cultures and contact/droplet precautions for control of methicillin-resistant Staphylococcus aureus. J Hosp Infect. 2002;51(2):126-32. DOI: 10.1053/jhin.2002.1200

11. Karynski M, Sabat AJ, Empel J, Hryniewicz W. Molecular surveillance of methicillin-resistant Staphylococcus aureus by multiple-locus variable number tandem repeat fingerprinting (formerly multiple-locus variable number tandem repeat analysis) and spa typing in a hierarchic approach. Diagn Microbiol Infect Dis. 2008;62(3):255-62. DOI: 10.1016/j.diagmicrobio.2008.06.019

12. Kuint J, Barzilai A, Regev-Yochay G, Rubinstein E, Keller N, Maayan-Metzger A. Comparison of community-acquired methicillin-resistant Staphylococcus aureus bacteremia to other staphylococcal species in a neonatal intensive care unit. Eur J Pediatr. 2007;166(4):319-25. DOI: 10.1007/s00431-006-0238-5

13. Kurlenda J, Grinholc M, Jasek K, Wegrzyn G. RAPD typing of methicillin-resistant Staphylococcus aureus: a 7-year experience in a Polish hospital. Med Sci Monit. 2007;13(6):MT13-8.

14. Leski T, Oliveira D, Trzcinski K, Sanches IS, Aires de Sousa M, Hryniewicz W, de Lencastre H. Clonal distribution of methicillin-resistant Staphylococcus aureus in Poland. J Clin Microbiol. 1998;36(12):3532-9.

15. Livermore DM. Can beta-lactams be re-engineered to beat MRSA? Clin Microbiol Infect. 2006;12 Suppl 2:11-6. DOI: 10.1111/j.1469-0691.2006.01403.x

16. Luczak-Kadlubowska A, Sulikowska A, Empel J, Piasecka A, Orczykowska M, Kozinska A, Hryniewicz W. Countrywide molecular survey of methicillin resistant Staphylococcus aureus strains in Poland. J Clin Microbiol. 2008;46(9):2930-7. DOI: 10.1128/JCM.00869-08

17. Marshall C, Wolfe R, Kossmann T, Wesselingh S, Harrington G, Spelman D. Risk factors for acquisition of methicillin-resistant Staphylococcus aureus (MRSA) by trauma patients in the intensive care unit. J Hosp Infect. 2004;57(3):245-52. DOI: 10.1016/j.jhin.2004.03.024

18. Matynia B, Mlodzinska E, Hryniewicz W. Antimicrobial susceptibility patterns of Staphylococcus aureus in Poland obtained by the National Quality Assurance Programme. Clin Microbiol Infect. 2005;11(5):379-85. DOI: 10.1111/j.1469-0691.2005.01105.x

19. Pan ES, Diep BA, Charlebois ED, Auerswald C, Carleton HA, Sensabaugh GF, Perdreau-Remington F. Population dynamics of nasal strains of methicillin-resistant Staphylococcus aureus – and their relation to community-associated disease activity. J Infect Dis. 2005;192(5):811-8. DOI: 10.1086/432072

20. Piechowicz L, Namysl E, Galinski J. Wystepowanie metycylinoopornych gronkowcow w Polsce i ich charakterystyka [Occurrence of methicillin-resistant strains in Poland and their characteristics]. Med Dosw Mikrobiol. 1993;45(3):273-6.

21. Rayner C, Munckhof WJ. Antibiotics currently used in the treatment of infections caused by Staphylococcus aureus. Intern Med J. 2005;35 (Suppl 2):S3-16. DOI: 10.1111/j.1444-0903.2005.00976.x

22. Savas L, Duran N, Onlen Y, Savas N, Erayman M. Prospective analysis of antibiotic susceptibility patterns of MRSA in a Turkish University Hospital. Turk J Med Sci. 2005;35:323-7.

23. Sola C, Gribaudo G, Vindel A, Patrito L, Bocco JL; Córdoba MRSA Collaborative Study Group. Identification of a novel methicillin-resistant Staphylococcus aureus epidemic clone in Córdoba, Argentina, involved in nosocomial infections. J Clin Microbiol. 2002;40(4):1427-35. DOI: 10.1128/JCM.40.4.1427-1435.2002

24. Tiemersma EW, Bronzwaer SL, Lyytikäinen O, Degener JE, Schrijnemakers P, Bruinsma N, Monen J, Witte W, Grundman H; European Antimicrobial Resistance Surveillance System Participants. Methicillin-resistant Staphylococcus aureus in Europe, 1999–2002. Emerg Infect Dis. 2004;10(9):1627-34.

25. Trampuz A, Zimmerli W. Antimicrobial agents in orthopaedic surgery: Prophylaxis and treatment. Drugs. 2006;66(8):1089-105. DOI: 10.2165/00003495-200666080-00005

26. Wertheim HF, Melles DC, Vos MC, van Leeuwen W, van Belkum A, Verbrugh HA, Nouwen JL. The role of nasal carriage in Staphylococcus aureus infections. Lancet Infect Dis. 2005;5(12):751-62. DOI: 10.1016/S1473-3099(05)70295-4

Corresponding author:
Prof. Dr. Krzysztof Piotr Bielawski
Intercollegiate Faculty of Biotechnology University of Gdansk and Medical University of Gdansk, Department of Biotechnology, Laboratory of Molecular Diagnostics, Kladki 24, 80-822 Gdansk, Poland, Phone: +48 58 523 63 14, Fax: +48 58 523 64 26
bielawski@biotech.ug.edu.pl

Please cite as
Paszko K, Michnowska E, Kurlenda J, Grinholc M, Nakonieczna J, Bielawski KP. MRSA distribution and epidemiological procedures evaluation at two hospitals in Northern Poland. GMS Krankenhaushyg Interdiszip. 2011;6(1):Doc19.
DOI: 10.3205/dgkh000176, URN: urn:nbn:de:0183-dgkh0001763

This article is freely available from
http://www.egms.de/en/journals/dgkh/2011-6/dgkh000176.shtml

Published: *2011-12-15*