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

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 in 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.**
- **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.
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

Table 1: The characteristics of the hospital in Gdansk

| Year | No. of beds | No. of hospitalizations | % patients' beds occupation | Average hospitalization time (days) | No. of microbiological 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 hospitalizations | % patients' beds occupation | Average hospitalization time (days) | No. of microbiological 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
• 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 isolation 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.

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