THE PREVALENCE OF STAPHYLOCOCCAL INFECTIONS IN AN EMERGENCY HOSPITAL FOR CHILDREN - A RETROSPECTIVE STUDY

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Abstract

Introduction: Infection is a matter of highest importance in pediatric pathology, and still remains a major cause of morbidity and mortality, despite the progress made Rational use of antibiotics is an essential part of patient safety and requires guidance and close supervision. Aim was to identify resistance phenotypes of strains of staphylococci in the pediatric population in our hospital. Material and methods: retrospective study, based on analysis of patients' records, those who were taken cultures between the aforementioned period. Isolation of germs was done on selective and non-selective media suitable and staphylococcal strains identification was done by conventional methods. All data was collected in Microsoft Excel. Results: Most of the cultures positive for Staphylococcus came from biological material collected from the nasal passages and larynx. There were no strains resistant to vancomycin, teicoplanin and linezolid. Best rate of sensitivity to antibiotics have had MSSA strains identified in pathological products from abscesses and wounds. The best results were presented to netilmicin. Conclusions: Our study showed that Isolated Staphylococcal strains are most frequent from all positive cultures. More than 75% of the isolated MSSA strains are resistant to more then two antibiotics. Identification and knowledge of these phenotypes of resistance is useful in initiating empiric therapy, especially in critical situations when etiological treatment cannot be delayed.

Key words: stphiloccocus aureus, antibiotic resistance, child

Introduction - The purpose of the paper

Infection diseases represent a matter of highest importance in pediatric pathology, and still remains a major cause of morbidity and mortality, despite the progress made in its prevention and treatment. Staphylococcal infection is one of the most frequently isolated nosocomial pathogens from intensive care unit patients [1] due to the increased ability of the bacteria to adapt to environmental factors [2], patient population diversity and the alarming rate of acquisition of new mechanisms of antibiotic resistance.

The value of antibiotics for human health is immeasurable. They have changed the life expectancy in the last 50 years and a plausible estimate of the increase in life expectancy attributable to antibiotics might be 2 to 10 years. [3] However, rational use of antibiotics is an essential part of patient safety and requires guidance and close supervision. Given the association between antibiotic use and selection of resistant germs, the frequency of inappropriate use of antibiotics is used as a surrogate marker of the impact of antimicrobial resistance that can be avoided.

The prevalence of staphylococcal infections, especially those caused by strains of MRSA in hospital, varies widely according to geographical areas. [4] MRSA infections are associated with a higher mortality than those due Methicillin susceptible S. aureus (MSSA) [5], which is explained by the greater resistance of MRSA strains to antibiotics, leading to an initial empirical treatment that most often will prove to be ineffective with negative effects on disease progression. [6].

The aim of this study was to identify resistance phenotypes of strains of staphylococci in the pediatric population in a Romanian pediatric referral hospital area.

Material and method

Design: retrospective study, based on analysis of patients' records between 01.06.2007-01.10.2007, a randomly chosen period of time. We collected the data from the Central Laboratory from Emergency Hospital for Children "Louis Ţurcanu" Timisoara using all the cultures that were performed in that arbitrary period.

Patients: We included all patients with signs or symptoms of infection, who were taken cultures between the above-mentioned interval of time.

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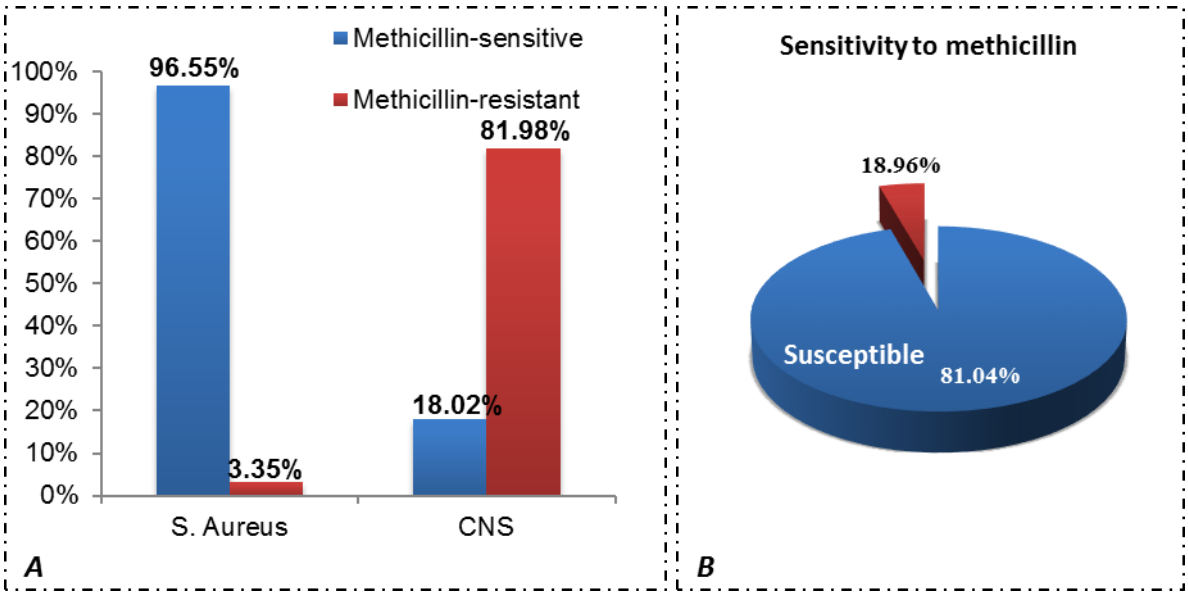

Fig. 1. The percentage of staphylococcal strains according to methicillin resistance

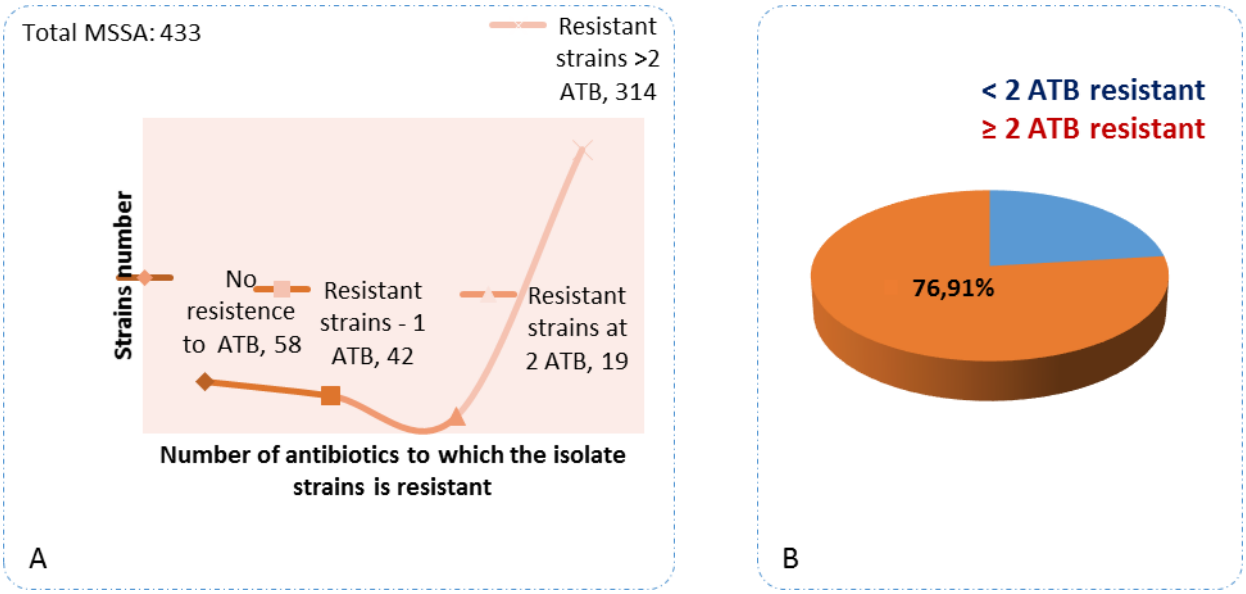

Fig. 2. Multi-resistant strains of MSSA

Isolation of germs from the pathological products was done on selective and non-selective media. Staphylococcal strains identification was done by conventional methods on Blood Agar media and MacConkey agar was used for the isolation of gram-negative enteric bacteria. Blood cultures were taken on Oxoid Signal blood culture system. Urine cultures were taken using urine bags (West spring) and urinary Foley catheter. The diagnosis of a urinary tract infection was confirmed by obtaining a urine culture with greater than 100000 colony forming units (CFU)/mL of one type of bacteria. For samples collected using a Foley catheters and urine bags, results of 1000 to 100000 CFU/mL were considered significant. We have started with the identification of antibiotic susceptibility of Staphylococcus strains isolated from different cultures taken from inpatients and outpatient who addressed our hospital during the study period.

Statistical analysis: all data was collected in a Microsoft Excel table. Statistical analysis was performed using Microsoft Excel 2007.

This study was approved by the Ethics Committee of "Louis Turcanu" Emergency Hospital for Children, Timisoara

Results

During the study, from a total of 7464 bacterial cultures, were isolated a number of 946 bacteria. Out of cultures analyzed - 559 (7.49 % of total pathological products) belonging to the Staphylococcus strains.

Staphylococcal strains isolated - 59% of all positive cultures, were the most frequent bacterial agents identified. From the statistical study we noted that the incidence of clinical entities rendering significantly different. We found that the most frequent staphylococci were isolated from respiratory tract (65%), followed by positive cultures from skin and soft tissue infections (Table 1).

We discovered that staphylococcal strains have frequently been isolated from the nasal swab and throat, representing 64.05% of positive cultures. In terms of skin and soft tissue infections in the sample studied, we found that a percentage of 8.05% of staphylococcal strains were isolated from the skin of the perianal area, groin and underarms. Staphylococcus isolated in the secretions from ear, conjunctiva, and umbilicus, and also from penis and vaginal parts accumulates a rate of 16.99%. In other products taken from the skin and soft tissue infections (wounds, pustules, abscesses) staphylococci were present in an amount of 5.72% of the total.

In regards to isolated staphylococcal species, we found that 448 strains, representing 80.14%, belong to the genus Staphylococcus aureus strains and 111, representing 19.86%, belong to coagulase-negative staphylococci (CNS). We noticed that the ratio between S. aureus and CNS was 4-1.

Resistance to methicillin has been studied for all the samples were the staphylococci existed. We found that 433 (representing 96.55%) of strains belonging to MSSA and only 15 (3.35%) strains were resistant to this antibiotic (MRSA). From the population of coagulase-negative staphylococci, 91 strains (81.98%) are resistant to methicillin and only 20 strains (18.02%) were susceptible to methicillin administration (Fig. 1A).

At the same time, regardless of the species of Staphylococcus, it appears that the susceptibility to meticillin is 81.04%, all the rest are resistant (Fig. 1B).

The MSSA population (433 strains) selected from all samples has revealed a sensitivity of 100% to glycopeptides (vancomycin and teicoplanin) and to the backup antibiotic (linezolid). Sensitivity to aminoglycoside study showed that 91.21% of the strains were sensitive to netilmicin. Testing strains to third generation cephalosporin's, showed that among strains of MSSA, 55.38% were susceptible to ceftriaxone. Percentage of moderately low sensitivity was found to combinations: amoxicillin / clavulanic acid and trimethoprim / sulfamethoxazole. Testing against oxacillin showed an increased level of resistance (54.62%). Average percentage of MSSA strains resistant to the antibiotics tested is 35.08% (Table 2).

Analyzing the association of antibiotic resistance in the same MSSA strains, we saw the presence of a total of 333 strains resistant to more than one antibiotic, the resistance being noticed for up to 9 antibiotics even for the same strain. A percentage of 76.91% of multidrug-resistant strains are identified (Fig. 2 A, B).

Differentiating the cases in relation to the primary site of staphylococcal infection, the sensitivity to the same antibiotic of the MSSA strains will be different and will depend on pathological product from which it was isolated. The percentage of antibiotic sensitivity was higher in the population of MSSA from the throat (62.54%) compared to the ones in the nasal passages (52.49%). In the conjunctivas secretion harvested and those from the external ear canal, MSSA isolates show a very low percentage (35.37%) of sensitivity to majority of the antibiotics. Althought there were no strains of MRSA isolated in these products, MSSA has a high resistance to most of the antibiotics tested. Netilmicin was the only antibiotic with good coverage (sensitivity of 88.98%) on the MSSA. Best rate of sensitivity to antibiotics have had MSSA strains identified in pathological products from abscesses and wounds (73.42%) and this strains are most susceptible to aminoglycosides tested (Table 2).

Table 1. The isolated staphylococcal strains share.

Site of infections	Number of bacterial strains isolated (%)
Respiratory tract infections	***363 (***64.94 %)
Skin and soft tissue infections	172 (30.77 %)
Medical device-associated infections	12 (2.15 %)
Systemic infections	7 (1.25 %)
Urinary tract	5 (0.89 %)
Species	**No. bacterial strains (%)**
Staphylococcus aureus	448 (80.14 %)
Coagulase-negative staphylococci	111 (19.86 %)

Table 2. MSSA sensitivity.

Antibiotic	Methicillin-sensitive S. aureus sensitivity				
	all samples studied	nasal swabs	pharyngeal exudate	conjunctiva secretions and ear	abscesses and wounds
Sensitivity rate	64.92 %	52.49 %	62.54 %	35.37 %	73.42 %
OX	45.38 %	35.71 %	65.78 %	28.33 %	69.23 %
AUG	67.78 %	67.88 %	68.10 %	59.52 %	71.42 %
CFP	55.38 %	57.50 %	48.48 %	52.79 %	71.42 %
RO	50.12 %	44.81 %	67.24 %	18.82 %	69.23 %
NET	91.21 %	92.55 %	88.59 %	88.98 %	92.30 %
GEN	51.06 %	46.87 %	69.29 %	20.83 %	85.71 %
K	28.33 %	24.20 %	37.06 %	17.85 %	53.84 %
E	27.01 %	23.07 %	38.88 %	8.82 %	50.00 %
BIS	60.14 %	61.18 %	69.64 %	26.90 %	83.33 %
CIP	67.55 %	71.16 %	71.42 %	41.67 %	84.61 %
TOB				24.61 %	
FEP					23.07 %
TZP					84.61 %
CES					91.66 %
IMP					83.33 %
MER					87.50 %
VA	100 %				
TEC	100 %				
LZD	100 %				

OX-oxacilin; AUG-amoxicillin-clavulanate; CFP-cefoperazone; RO-ceftriaxone; Net-netilmicin; GEN-gentamicin; K-kanamycin; E-erythromycin; BIS-thrimetoprim-sulfamethoxazole; CIP-ciprofloxacin; TOB-tobramycin; FEP-cefepime; TZP-piperacillin-tazobactam; CES-cefoperazone-sulbactam; IMP-imipenem; MER-meropenem; VA-vancomycin; TEC-teicoplanin; LZD-linezolid

Discussion

Infections caused by staphylococci will spread easily through interpersonal contact, most often occurring in the first instance by direct colonization, producing or not overt infection, depending on demographic factors and host susceptibility to infections.

In this study, following statistical analysis we obtained a procent of 3.35% of MRSA strains of S. aureus population tested (448 positive cultures for S. aureus). For a correct appreciation of the report MRSA / MSSA ratio it is important to study relevant strains isolated from pathological products [8]. For this reason, we excluded from this analysis isolates from throat and nasal secretions, skin, axillary, inguinal and perianal areas, as staphylococcal strains in these regions are frequently colonized and may not reflect an infection. Thus we obtained a rate of 9.37% MRSA (9 strains of all 96 remaining pathological product which was isolated Staph. aureus), a percentage of 2.7 times lower than that reported by Romania in 2007 by the network European antibiotic resistance surveillance -EARS-Net (26%). [13]

In our study, most cultures positive for Staphylococcus came from biological material collected from the nasal passages and larynx. In most studies, these places are cited as anatomical areas usually colonized. The primary location of staphylococci to this level is associated with the development of bacteremia [9].

Resistance to antibiotics was prevalent in strains harvested from the conjunctival secretion and the external ear canal as MSSA isolates susceptibility showed a very low percentage (35.37%). Testing tobramycin, the aminoglycoside antibiotic commonly used in external infections of the eye and ears showed a very low sensitivity of MSSA (24.61%).

Best rate of sensitivity to antibiotics have had MSSA strains identified in pathological products from abscesses and wounds (73.42%). For abscesses or carbuncles, some studies have emphasized the extreme importance of drainage, antibiotic therapy beeing only adjuvant or it can be a first line of treatment in case of afebrile children [10]. The antibiotic may be administered topically together with a strict hygiene of the skin [11].

The best results were presented to netilmicin, but widespread use of this antibiotic, unless really needed as in severe infections, in Intensive Care Unit (ICU) or hematology oncology cases, could lead to the selection of staphylococcal strains resistant to this antibiotic. Netilmicin, when used routinely for mild infections, will lead to unwanted adverse effects.

There were no strains resistant to vancomycin, teicoplanin and linezolid. MRSA and the coagulase-negative

staphylococci resistant to Methicillin were all sensitive to gliopeptide and linezolid. Linezolid has limited clinical experience in pediatric infectious pathology [11].

In assessing the results, we took into account that methicillin-resistant S. aureus (MRSA), according to Clinical and Laboratory Standards Institute (CLSI) 2006 show resistance to all penicillins, all combinations betalactamine / beta-lactamase inhibitors, cephem (cephalosporins) and carbapenems. These, although they may be active in vitro, are not clinically effective. To these antibiotics MRSA strains are usually reported as being resistant [7].

The data cited by the literature was similar to the results of the current study, most of the SCN were resistant staphylococci and vancomycin was the recommended empiric treatment in infections with these pathogens. The combination of rifampicin or gentamicin with vancomycin may increase efficacy [12].

The restriction in prescribing these antibiotics and medical education could prevent or reduce antimicrobial resistance.

Medical care increases the risk of acquiring a staphylococcal infection, particularly multidrugresistant strains to antibiotics. According to statistics from the literature, [14] [15] staphylococcal infection was the most common cause of infection associated with mechanical ventilation, surgical wound infection and bacteremia due to intravenous devices. [16, 17, 18]

Identification and knowledge of these phenotypes of resistance was useful in initiating empiric therapy, especially in critical situations when etiological treatment cannot be delayed.

As empirical antibiotic management strategies we suggested using netilmicin, amoxicilline-clavulanate or trimethoprim/sulfamethoxazole (TMP/SMX). For patients with history of allergies or severe infection, looks like the empiric treatment should have been gentamicine.

In conjunctivae or ear infections caused by MSSA, as initial therapy we used empirical netilmicin or amoxicilline-clavulanate.

In the empirical treatment of skin staphylococcal infection (abscess, wound) gentamicin and oxacillin or netilmicin can be used and in severe infections, polymicrobial or in case of allergy to β-lactams then vancomycin ± gentamicin or vancomycin + imipenem.

The lack of alternatives for empirical treatment was an important risk factor for selecting strains resistant to tobramycin and amoxicillin / clavulanic acid, and raises the question of their use as antimicrobial therapy in some situations. The best results in vitro had shown netilmicin, but widespread use of this antibiotic may lead to selection of resistant staphylococcal strains. TMP/SMX can be a good alternative, per os.

We did not test Clindamycin because, despite some studies that provide in soft tissue infections this substance, in other two recent papers from our country the efficiency was disputable [19]. Although the literature cites the emerging number of strains resistant to vancomycin and linezolid, during our study period there were no strains isolated to be resistant to these antibiotics.

Conclusions

Most staphylococci were isolated from the respiratory tract, followed by those of the skin and soft tissues. The strains of Staphylococcus aureus were 4 times more frequently isolated then the strains of coagulase-negative staphylococci. Most of the staphylococcal strains isolated were susceptible to methicillin. More than 75% of the isolated MSSA strains were resistant to more then two antibiotics. The highest levels of sensitivity were noted to netilmicin, and it may be a treatment option in some cases, in view of the high sensitivity in vitro to this drug. Oxacilin was not an option for hospitalized patients with those strains. Glycopepdides were still an option in our severe cases.

Limitation of our study: data collected from a single Hospital, and the sole period of time, randomly, without a separation between the hospital wards, and between different age groups.

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