

REVIEW ARTICLES

Epidemiologic surveillance control issues and optimization methods of nosocomial purulent-septic infections of newborns and women in labor

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Abstract

The problems of nosocomial purulent-septic infections (NPSI) in newborns and women in labour still appear to be actual for public health care system because of NPSI wide distribution and their social and economic affection. The undertaken studies have revealed that true NPSI morbidity of the newborns and women in labor exceeds the data in official documents by 10 times. During continuous microbiological screening of the material taken from patients and from hospital environmental objects it has been established that the epidemic NPSI niduses are caused by the circulation of nosocomial strains. Extra hospital strains do not provoke infectious and inflammatory processes development in 70.4% of cases. Extra hospital strains cause individual NPSI maladies in 21.0% of cases and only in 1.9% they form the epidemic centres of two and more cases. The research shows that the INPSI agents isolated from the medical wastes after disinfection, in comparison with the microorganisms isolated before the disinfection process, are characterized by virulence and the resistance to poly-antibiotics and used disinfectant. Therefore, in the absence of patients with NPSI signs in a particular in-patient department, the identification of microorganisms' strains can be carried out by a usual bacteriological examination of disinfected hospital wastes. In conditions of medical preventive institutions and the medical insurance system NPSI damage can be economically determined by laboratory expenses, antibacterial and general health treatment expenses, plus the basic tariffs without the average examination and treatment costs.

Key words: newborns, pregnancy, purulent-septic infections, epidemiology.

Реферат

Проблемы внутрибольничных гнойно-септических инфекций (ВГСИ) у новорождённых и рожениц по-прежнему остаются актуальными для здравоохранения ввиду их широкого распространения и социально-экономической значимости. Исследования показали, что истинная заболеваемость ВГСИ у новорождённых и рожениц в 10 раз выше официально зарегистрированной. Продолжительное микробиологическое исследование материала, взятого у больных и из объектов больничной среды, показало, что эпидемические очаги ВГСИ связаны с циркуляцией внутрибольничных штаммов. Внебольничные штаммы в 70,4% случаев не вызывают развития инфекционных или воспалительных процессов. Эти штаммы вызывают отдельные заражения ВГСИ в 21% случаев и только в 1,9% случаев формируют эпидемические очаги с двумя и более числом заболевших. Исследования показывают, что возбудители, выделенные из медицинских отходов после дезинфекции, в отличие от микроорганизмов, изолированных до дезинфекции, характеризуются вирулентностью, а также полиантибиотикорезистентностью и устойчивостью к используемому дезинфектанту. Таким образом, при отсутствии в частной клинике пациентов с признаками ВГСИ идентификация микробных штаммов может быть проведена при помощи обычного бактериологического исследования дезинфицированных медицинских отходов. В условиях медицинских профилактических учреждений и системы медицинского страхования экономический ущерб от ВГСИ может быть оценён по лабораторным затратам, стоимости общего и антибактериального лечения, плюс базовые тарифы без средней стоимости обследования и лечения.

Ключевые слова: новорожденные, беременные, гнойно-септические инфекции, эпидемиология.

The problems of nosocomial purulent-septic infections (NPSI) in newborns and women in labour appear to be important for public health care system because of their wide distribution and social and economic affection. But at the same time many issues of the infections epidemiological surveillance and control are insufficiently worked out and need further improvement. The present report shows the ultimate results of the author's epidemiologic observations of NPSI cases at the medical institutions in Perm region.

The undertaken studies have revealed that the true morbidity of newborns and women in labour as a result of NPSI, according to medical documents seemed to be 10 times as much as the officially registered data [1, 2]. The unsatisfactory records of NPSI morbidity rates of newborns and women in labour were based on a low level of patient data found at the

obstetrical, neonatal and gynecological out-patient departments. It is due to the absence of standard epidemiologic practical application definitions of pneumonia cases in the newborns and urinary infections (UI) in women in labour. So, we have worked out corresponding standard epidemiologic definitions. We have concluded that pneumonia among full-term and premature newborns should be registered only in case of a lung inflammatory reaction shown in the chest X-ray and the presence of at least one of such symptoms as apnoea, rale or sputum [3]. UI in pregnant women and women in labor should be diagnosed if microorganisms are revealed in the central urine portion in the concentrations not lower than 100,000 KOE/ml or have 4000 leucocytes in the same portion.

The patients should also have not less than 3 signs: hyperthermia from 37°C and higher, microorganisms in

non-centrifuged urine, more than 10 leucocytes in the urine specimen, 30 or more leucocytes in a urethra smear, microorganisms in the urine central portion (in concentrations not less than 100 KOE/ml for enterobacteria and non-ferment bacteria, and 5000 KOE/ml for other microorganisms). The diagnosis of UI should be confirmed by a kidney ultrasonography examination; the ward doctor should also administer antimicrobial therapy [4, 5].

It has been discovered that every fourth newborn having omphalitis and conjunctivitis showed such pre-nosologic symptoms as lacrimation, edema or conjunctive hyperemia, umbilical ring edema or hyperemia and umbilical wound discharges. Besides, conditionally pathogenic microorganisms (CPM) incidence increase could precede newborns NPSI morbidity growth. We recommend registering newborns pre-nosologic NPSI types, including CPM carriers and use them for pre-epidemiological diagnostics, preventive insitutions treatment and anti-epidemiologic measures at the obstetrical departments [6].

At present the major causative PSI agents are coagulase-negative staphylococcus (CNS); they constitute more than 30%. PSI in general and PSI associated with CNS involve infants of an early neonatal period in the epidemic process, predomination of omphalitis and conjunctivitis in the clinical form structure is also characterized by seasonal morbidity increase absence. PSI contamination of first month infants usually occurs at the obstetrical and neonatal departments, though it is rarely met during home treatment [6].

One of the risk factors of the newborns NPSI is a low body weight in labour. An increased level of omphalitis in combination with a low body weight results more often in umbilical vessel catheterization [7].

The use of genetic typing causative agent method and phenotypical sign assessment results allowed us to reveal the outbreak of ventilator associated pneumonia caused by *Pseudomonas aeruginosa* among the newborns in resuscitation and intensive care departments. We have found out that the outbreak was caused by the catheter microbe contamination. The catheter was used for mucous suction during artificial lung ventilation procedure. It was due to the personnel's hands at the moment of connecting the catheter with the electric sucker aspiration tube [8].

It is known that an epidemic situation at the in-patient department is not provoked by all microorganisms circulating in it. Mainly the most severe clinical infectious pathology forms are caused by only those microorganisms which are adapted to hospital conditions. The long-term prospective research carried out by us in different profile hospitals showed that the increased virulence of nosocomial (hospital) strain (clone) PSI agents was their universal and obligatory characteristics. The appearance of a PSI epidemic nidus is due to this virulence [1]. The epidemiological case-control research study has been performed for the identification of the typical signs of nosocomial strains. During the research such signs of washouts microorganisms as beta-lactamase production, polyresistance to antibiotics, frequency of patients' colonization and frequency of strain allocation from the hospital envi-

ronment objects, contamination of the used disinfectant and the raw objects with the strain, resistance to applied solution of a disinfectant have been studied. A comparative assessment of these signs occurrence in the group of the strains allocated from the epidemic niduses of 5 and more cases (nosocomial strains) and strains of an extra hospital origin (isolated cases of PSI) with the subsequent sensitivity and specificity assessment of each sign allowed the revealing of special criteria on the basis of which an epidemiological standard definition for a nosocomial strain has been formulated. The existence of natural or acquired pathogenic characteristics, colonization by a strain of not less than 30% of patients at the department and its resistance to the applied solutions of the used disinfectants appeared to be the typical signs of nosocomial strains.

During continuous microbiological screening of the material taken from patients and hospital environment objects it has been established that the epidemic PSI niduses are caused by nosocomial strains [4]. The out-of-hospital strains do not result in infectious and inflammatory process development in 70.4% of cases. The out-of hospital strains have caused individual cases of PSI in 21.0%, and only in 1.9% they have formed the epidemic centres of two and more cases.

Different forms of hospital environmental microbiological monitoring comparison has revealed [9, 10] that microbiological monitoring of the samples of sanitary and indicative microorganisms – *Coliforms* and *Staphylococcus aureus* – (the first organizational form) has showed that the number of the tests containing a nosocomial strain has been $1.5 \pm 0.3\%$. It has been determined that the monitoring of the washouts on CPM (the second form of monitoring) determined that $12.5 \pm 1.0\%$ of tests were positive for nosocomial strains. The target research monitoring of washouts on nosocomial strains (the third form of monitoring) revealed the microbial contamination of the hospital environment in $34.8 \pm 2.0\%$ of cases. Three organizational forms of monitoring applied in the same medical institutions at the same time revealed various levels of a microbial contamination of environmental objects with nosocomial strains and different degrees of their epidemic risk. The correlation analysis identified a strong direct link between the indicators of PSI morbidity rate and the contamination level of hospital environment objects with the nosocomial strain identified during the third form of monitoring. The correlation factor r has been 0.98 ($p = 0.0001$). Received during the first and second organizational forms of monitoring direct dependence of PSI morbidity indicators and the findings of external environment objects research has not been revealed. The calculations have indicated that the third microbiological monitoring of the hospital environment is the most economic.

The undertaken have studies showed that the NPSI agents isolated from medical wastes tests after disinfection, in comparison with the microorganisms isolated before the disinfection process have been characterized by virulence factors and the resistance to poly-antibiotics and the used disinfectants. Therefore, in the absence of patients with PSI signs in a particular in-patient department the identification

of the strains of microorganisms can be carried out by the bacteriological examination of disinfected hospital wastes [11].

The introduction of the project "Mother and Child" at the obstetrical departments is an essential resource for high quality and efficiency of epidemiological control of PSI cases in newborns and women in labour. As a result of the project implementation at the experimental hospitals the NPSI morbidity rate of newborns and women in labor has decreased by 1.2 and 1.3 times respectively, while in the control group of hospitals the NPSI morbidity rate growth has been 1.3 times as much in newborns and the stabilization of NPSI morbidity rate among women in labor has been noted [12]. It is confirmed that rooming in with a baby in a postnatal ward is an epidemiologically effective action of the project "Mother and Child". Providing the close contact between the woman in labor and the newborn and separating them from other patients and personnel contributes to the formation of the normal micro flora of the child and results in significant NPSI decrease in newborns [13]. The increase of micro organic coincidence in form and antibiotic phenotype of microorganisms isolated from women's in labor and newborns' skin integuments with placing a baby on the mother's abdomen testifies that postpartum skin-to-skin contact of the child and woman in labour plays a very important role in the formation of the newborn's microbiocenosis [14].

In conditions of medical preventive institutions and the medical insurance system the nosocomial PSI damage should be economically determined by laboratory assessment expenses, antibacterial and general health treatment expenses, plus the basic tariffs without an average examination and treatment costs. So, on January 1, 2008, economic damage from non-general PSI cases of newborns (omphalitis, conjunctivitis, skin PSI) was on average 7510 roubles, what is equivalent to 306 US dollars or 209 euros. The economic damage from a case of puerperal postnatal endometritis was equal to 8722, what corresponds to 355 US dollars or 243 euros and the damage from a case of postpartum mastitis was 7540 roubles, what is equivalent to 307 US dollars or 210 euros [15].

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