BACTERIOLOGICAL EVALUATION OF DEEP PERIPROSTHETIC INFECTION FOLLOWING TOTAL HIP JOINT ARTHROPLASTY

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Annotation: Periprosthetic infection remains one of the most serious complications after total hip arthroplasty and is associated with prolonged treatment, repeated surgical interventions, and significant functional impairment. The aim of this study was to investigate the bacteriological spectrum of pathogens responsible for deep periprosthetic infection after total hip arthroplasty and to develop rational approaches to antimicrobial therapy based on microbiological findings.

A bacteriological (culture-based) examination was performed in 88 patients with purulent draining wounds complicated by periprosthetic infection following total hip arthroplasty. The microbial spectrum was studied, and pathogen identification with antimicrobial susceptibility testing was performed. *Staphylococcus aureus* was the predominant microorganism and was detected in 51 patients (57%). Other identified pathogens included *Pseudomonas aeruginosa* — 10 cases (11.3%), *Staphylococcus haemolyticus* — 9 cases (10.2%), *Enterobacter spp.* — 8 cases (9%), *Staphylococcus epidermidis* — 5 cases (5.6%), *Escherichia coli* — 4 cases (4.5%), and *Klebsiella spp.* — 1 case (1%). Mixed bacterial-fungal infection with Candida species was detected in 45 patients. *Candida albicans* was the most common fungal pathogen and contributed to biofilm formation and persistence of infection.

The study demonstrates that effective management of deep periprosthetic infection requires early diagnosis, radical surgical debridement, implant removal when indicated, antibiotic-loaded cement spacer implantation, and targeted antimicrobial therapy based on bacteriological results. The use of Microdacyn 60 superoxidized antiseptic solution promotes rapid elimination of microorganisms, preserves healthy tissues, and contributes to primary wound healing.

Аннотация: Перипротезная инфекция является одним из наиболее тяжелых осложнений после тотального эндопротезирования тазобедренного сустава, сопровождающимся длительным лечением, необходимостью повторных хирургических вмешательств и значительным нарушением функциональных результатов. Целью данного исследования являлось изучение бактериологического спектра возбудителей глубокой перипротезной инфекции после тотального эндопротезирования

тазобедренного сустава и разработка рациональных подходов к антимикробной терапии на основе результатов микробиологических исследований.

Проведено бактериологическое (культуральное) исследование у 88 пациентов с гнойными свищевыми ранами, осложненными перипротезной инфекцией после тотального эндопротезирования тазобедренного сустава. Выполнена идентификация микроорганизмов и определение их чувствительности к антибактериальным препаратам. Наиболее часто выявленным возбудителем являлся *Staphylococcus aureus*, обнаруженный у 51 пациента (57%). Другие микроорганизмы были представлены: *Pseudomonas aeruginosa* — 10 случаев (11,3%), *Staphylococcus haemolyticus* — 9 случаев (10,2%), *Enterobacter spp.* — 8 случаев (9%), *Staphylococcus epidermidis* — 5 случаев (5,6%), *Escherichia coli* — 4 случая (4,5%), *Klebsiella spp.* — 1 случай (1%). У 45 пациентов выявлена смешанная бактериально-грибковая инфекция с участием Candida spp. Наиболее часто встречался грибковый возбудитель *Candida albicans*, который играет важную роль в формировании биопленок и поддержании хронического инфекционного процесса.

Полученные результаты свидетельствуют о том, что эффективное лечение глубокой перипротезной инфекции требует ранней диагностики, проведения радикальной хирургической обработки, удаления имплантата по показаниям, установки цементного спейсера с антибиотиком и назначения целенаправленной антимикробной терапии на основании результатов бактериологического исследования. Применение супероксидированного антисептического раствора Microdacyn 60 способствует быстрому уничтожению микроорганизмов, сохранению жизнеспособных тканей и улучшению процессов первичного заживления раны.

Keywords: Deep periprosthetic infection; total hip arthroplasty; hip joint replacement; bacteriological evaluation; microbial spectrum; antimicrobial susceptibility testing; *Staphylococcus aureus*; *Candida albicans*; biofilm; antibiotic resistance; surgical debridement; cement spacer.

Ключевые слова: Глубокая перипротезная инфекция; тотальное эндопротезирование тазобедренного сустава; замена тазобедренного сустава; бактериологическое исследование; спектр микроорганизмов; антибиотикочувствительность; *Staphylococcus aureus*; *Candida albicans*;

биопленка; антибиотикорезистентность; хирургическая санация; цементный спейсер.

Relevance of the Study

Treatment of periprosthetic infection is a complex process that requires prolonged and intensive management. Successful treatment of purulent complications following total joint arthroplasty requires early diagnosis and timely active surgical intervention. Worldwide, more than one million arthroplasty procedures are performed annually. Periprosthetic infection develops in approximately 1–3% of cases after primary arthroplasty and in 7–30% of cases after revision arthroplasty. These data indicate that the treatment of periprosthetic infection may become a significant clinical challenge in the near future.

With the rapid development of total hip arthroplasty, the problem of surgical eradication of deep infectious foci has become increasingly important. The main causes of treatment failure are associated with polymicrobial infections, antibiotic resistance of microorganisms (including methicillin-resistant *Staphylococcus aureus*), and fungal colonization of postoperative wounds. Analysis of the literature demonstrates that information regarding Candida species within the bacteriological spectrum of periprosthetic infection pathogens remains limited.

Aim of the Study

To perform bacteriological analysis of pathogens causing periprosthetic infection after total hip arthroplasty and to develop targeted, rational antibiotic therapy based on microbiological findings.

Clinical Material and Methods

A bacteriological (cultural) examination was performed in 88 patients with purulent draining wounds complicated by periprosthetic infection following total hip arthroplasty.

The following microorganisms were identified:

Staphylococcus aureus — 51 patients (57%);

Pseudomonas aeruginosa — 10 patients (11.3%);

Staphylococcus haemolyticus — 9 patients (10.2%);

Enterobacter spp. — 8 patients (9%);

Staphylococcus epidermidis — 5 patients (5.6%);

Escherichia coli — 4 patients (4.5%);

Klebsiella spp. — 1 patient (1%).

A significant finding was the detection of mixed infection with candidiasis in 45 patients. In most cases, *Candida albicans* was responsible for fungal periprosthetic infection and contributed to biofilm formation. Uncontrolled antibiotic therapy, the use of hormonal medications, and reduced immune status create favorable conditions for Candida proliferation. In such cases, implant removal is often required.

Staphylococcus aureus, a Gram-positive bacterium, is considered one of the most aggressive pathogens in periprosthetic infections. *Pseudomonas aeruginosa* is a Gram-negative opportunistic pathogen capable of causing pulmonary, intestinal, and urinary tract infections. Urinary tract infections may contribute to the development of periprosthetic infection through lymphogenous spread.

Enterobacter spp. are Gram-negative microorganisms that, despite being intestinal saprophytes, may cause severe infections of the urinary tract. *Staphylococcus epidermidis* is a conditionally pathogenic microorganism normally present on the skin and mucous membranes; however, it can rapidly cause wound infections, particularly through catheter-associated urinary tract infections.

Escherichia coli is a Gram-negative bacterium; pathogenic strains may cause enteritis, cystitis, and pyelonephritis affecting the gastrointestinal and urinary systems.

In every case, bacteriological examination and antimicrobial susceptibility testing are essential for selecting appropriate antimicrobial therapy, including the use of moxifloxacin, vancomycin, cefoperazone, rifampicin, levofloxacin, fosfomycin, fluconazole, itraconazole, and other agents.

Surgical Treatment of Periprosthetic Infection

Surgical treatment of periprosthetic infection is performed in two stages.

The main principles of the first stage include careful removal of the implant from the bone structures, radical debridement with necrosectomy and sanitation of the infected tissues, followed by placement of an individual antibiotic-loaded cement spacer.

The second stage is performed after complete integration of the cement spacer, wound healing, and a remission period of 4–6 months. Revision total hip arthroplasty is performed when laboratory parameters (white blood cell count, erythrocyte sedimentation rate, C-reactive protein level, urinalysis, and biochemical parameters) return to normal values.

In our surgical practice, in addition to radical wound necrosectomy, we extensively irrigated infected tissues with **Microdacyn 60 superoxidized electrolyzed solution** to ensure rapid elimination of bacteria, viruses, and fungi

and to promote primary wound healing. According to published data, this solution is capable of destroying bacteria and fungi within 30 seconds.

This antiseptic is particularly effective for the sanitation of draining sinus tracts identified after implant removal, intermuscular phlegmon cavities, acetabular defects, and purulent cavities located posterior to the acetabulum. It allows pressure irrigation of anatomically difficult-to-access areas where complete mechanical debridement is challenging and enables temporary tamponade with antiseptic-soaked gauze for several minutes.

Additional rinsing after application of this antiseptic is not required. Microdacyn has a neutral pH level, does not damage healthy tissues, and has a positive effect on wound healing.

Conclusions

1.In addition to bacterial and viral agents, fungi play a significant role in the development of periprosthetic infection. Rational antimicrobial therapy should always be based on the results of bacteriological examination and antimicrobial susceptibility testing.

2.Microdacyn 60 superoxidized antiseptic rapidly eliminates bacteria, viruses, and fungi without damaging healthy tissues and has a beneficial effect on primary wound healing.

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