

Application of aldehyde solutions of weak concentrations in complex therapy of infected wounds of extremities

Abstract

This article shows that a mixture of glutaric and formaldehyde solutions of low concentration (0.05%-0.25%) has a synergistic effect, suppresses the reproduction of microbial populations, leads to a pronounced bactericidal effect and prevents the development of wound infection.

Keywords: aldehyde, wounds, microorganism

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Introduction

The relevance of the problem of treatment and prevention of purulent wounds of extremities does not lose its social significance at the present time. In recent decades a number of important and promising methods of treatment of infected wounds have been introduced into public health practice. First of all, it is radical surgical sanitation with the use of antibacterial drugs of directed action, vacuumization, ultrasonic cavitation of wounds, the use of laser beams, hyperbaric oxygenation, etc.^{1,2}

Intra-arterial and regional infusion of antibiotics and antiseptics, highly effective hormonal, enzyme, hydrogel preparations are also used.³ The introduction of flow-aspiration drains, vacuum therapy^{4,5} fundamentally changed the approach to wound drainage methods. In specialized surgical departments it became possible to turn surgical treatment of wounds into a primary restorative surgery. However, despite the existing successes, purulent infection is still a multifactorial problem.¹ In this regard; the search for simple, effective and economical ways to treat purulent wounds is of applied and social importance.

It has been established that aldehydes in certain concentrations are constantly present in the human body and actively participate in metabolic processes.⁶ Considering the bacteriostatic action of weak solutions of glutaric and formal aldehydes, we used the latter in the treatment of infected wounds of extremities.^{7,8}

Materials and methods

Solutions of 0.01-0.5% formaldehyde and 0.25-0.5% glutaric aldehyde were prepared from concentrated solution of neutral formalin (37% formaldehyde solution) and 25 or 50% glutaric aldehyde. The solvent was 0.9% sterile sodium chloride solution. The prepared solutions were mixed in a 1:1 ratio and the pH of the medium was adjusted to 7.2-7.4 using phosphate buffer at the rate of 5-10 ml for each liter of mixture. The infected wounds were treated by radical surgical treatment with excision of nonviable tissues and removal of the pathological focus. During the surgical intervention, 3 biopsy specimens taken from the area of the infected prosthesis were collected and sent for microscopic examination. Culture, identification and determination of antibacterial sensitivity were

performed in accordance with the current instructions.⁹ A double-lumen perforated micro irrigator was preliminarily placed in the subcutaneous tissue, through which continuous flow-through washing of the wound with the indicated mixture of aldehydes was performed. Wounds were irrigated for 7-10 days. The efficacy of the treatment of infected wounds of the extremities was studied in 143 patients of the traumatological profile of the Clinical Emergency Hospital of Grodno. Two groups of patients were distinguished.

The first, the main group (71 patients), treated infected wounds after surgical treatment with weak solutions of aldehyde mixtures. In the second, control group (72 patients), depending on the wound process, treatment was performed using 10% hypertonic sodium chloride solution or Chlorhexidine.

Results and discussion

Radical surgical treatment of infected limb wounds was performed in 112 patients. Microbiological monitoring of 245 cultures showed that the causative agent of the infected wounds was more often *Staphylococcus aureus* (30, 4%), less often-representatives of gram-negative microflora (*Acinetobacter baumannii* complex, *Klebsiella pneumoniae ssp pneumoniae*, *Pseudomonas aeruginosa*) which comprised 22, 2%. When analyzing the results of sensitivity of isolated cultures of microorganisms to antibacterial drugs it was found that the strains of *Staphylococcus aureus* showed high sensitivity to gentamicin, ofloxacin, amikacin and were resistant to ampicillin, oxacillin, chloramphenicol. Representatives of gram-negative microflora were resistant to most antibiotics. Thus, in infections caused by *Pseudomonas aeruginosa* sensitivity was noted only to amikacin, cefoperazone, meropenem, and resistance to chloramphenicol, rifampicin, nitrofurantoin, quinpristine, moxifloxacin, oxacillin. *Acinetobacter baumannii* complex and *Klebsiella pneumoniae ssp pneumoniae* strains were sensitive to gentamicin, amikacin, ceftazidime and resistant to cephalothin, cotrimaxazole. The study of antiseptic properties of equivolume mixtures of formol and glutaric aldehyde on wound microflora showed that the mixture of these antiseptics has a pronounced bactericidal and bacteriostatic action due to their synergistic action. At the same time, it does not have a damaging effect on living tissues, which was proved by cytological, bacteriological and microscopic studies. Thus, irrigation of infected

wounds of extremities of various genesis with a mixture of aldehyde solutions suppresses the reproduction of microbial populations, leads to a pronounced bactericidal effect and prevents the development of wound infection.

Conclusion

- 1) A mixture of glutaric and formal aldehyde solutions of weak concentrations (0.05%-0.25%) has a synergistic effect, has a bacteriostatic effect against pathogenic microflora.
- 2) The leading causative agents of infected wounds of the limbs are *Staphylococcus aureus* (30, 4%) and Gram-negative microflora (22, 2%);
- 3) The drugs of choice for rational antibiotic therapy in infected wounds of the extremities are *ofloxacin*, *amikacin*, *cefaperazone*, and *gentamicin*.
- 4) High bacteriostatic activity of mixtures of aldehyde solutions served as the basis for their use for the treatment of infected wounds of the extremities and allowed to obtain good clinical results.

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None

Conflicts of interest

The authors declare no conflict of interest.

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