LOCAL ANTIBACTERIAL TREATMENT IN PATIENTS WITH INFECTED PANCREATIC WALLED-OFF NECROSIS: A SYSTEMATIC REVIEW

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Summary

Introduction. Systemic antibacterial treatment in patients with infected pancreatic necrosis often fails to resolve the infection due to impaired penetration in necrotic areas. The endoscopic step-up approach based on endoscopic transmural drainage followed, if necessary, by endoscopic necrosectomy has become the standard of care in patients who do not respond to systemic antibiotics. The additional local administration of antibiotics may increase their concentration in necrotic tissue.

Aim. To evaluate the efficacy of local infusion of antibacterial agents to the site of infection in addition to systemic treatment after endoscopic drainage to resolve the infection and decrease the need for necrosectomy in patients with walled-off infected pancreatic necrosis.

Materials and methods. Major databases were searched for clinical studies assessing the efficacy of local perfusion of antibiotics for the treatment of infected pancreatic necrosis.

Results. Four studies were included, two cohort studies and two single-case reports. The majority of patients with infected pancreatic necrosis developed polymicrobial infection. More than one-third of patients additionally had fungal infection. Local irrigation of antibiotics in patients with infected pancreatic necrosis resulted in the eradication of bacteria and fungi, avoiding necrosectomy in almost half of cases. No local or systemic side effects were reported with this strategy.

Conclusions. Evidence evaluating the efficacy of local antibiotics for the treatment of infected pancreatic necrosis is scarce. Simultaneous local and systemic administration of antibiotics after endoscopic drainage could reduce the need for necrosectomy. Randomized clinical trials are needed to evaluate the impact of adding local to systemic antibiotics in the prognosis of patients with infected pancreatic necrosis.

Keywords: pancreatic necrosis, step-up approach, infection, local antibiotic infusion, necrosectomy

INTRODUCTION

Acute pancreatitis (AP) is one of the most common acute diseases of the digestive system [1]. Although overall mortality associated with AP is gradually declining, persistent multiorgan failure or the development of infected pancreatic necrosis (IPN) in the presence of severe acute pancreatitis (SAP) leads to high mortality rates [2]. SAP has two peaks of mortality during its course. The first and highest occurs during the first two weeks (early phase) after the onset and is characterized by persistent systemic inflammatory response syndrome (SIRS) and persistent organ failure (POF). The second peak of mortality is observed later on and is associated with IPN and its complications [2].

Since septic shock is the leading cause of death in patients with IPN, antibiotics play the leading role in the treatment. Prophylactic antibiotics failed, however, to improve outcomes in patients with IPN [3]. Systemic antibiotics usually fail to reach therapeutic concentrations in necrotic areas due to impaired perfusion [4-6], being quinolones and carbapenems are those with the best penetration rates in necrotic areas [7, 8] and, therefore, generally recommended for the systemic treatment of IPN [9].

The invasive strategy of IPN management has changed in recent years mainly due to the publication by the Dutch Groups of PANTER and TENSION trials [10,11]. These studies showed that the step-up use of...
percutaneous drainage and minimally invasive video-assisted retroperitoneal debridement was as effective but safer than open surgery for IPN [10]. The endoscopic step-up approach, based on transgastric drainage and endoscopic necrosectomy is as effective, but with less morbidity, than the minimally invasive surgical step-up approach [11]. Based on these results, endoscopic drainage of IPN is recommended as the standard of care for IPN after failure of systemic antibiotic therapy [12]. However, despite this approach, about three out of every four patients still require necrosectomy for the resolution of IPN [11].

Previous retrospective studies have shown promising results on the effect of local infusion of antibiotics through a nasocystic tube in patients with IPN in terms of the need for necrosectomy [13]. Based on the diffusion ability of antibiotics, the association of local and systemic administration of antibiotics may help to increase their concentration in the necrotic tissue [14]. To what extent this strategy can decrease the need for necrosectomy is unknown. The present study aimed to evaluate the efficacy of local infusion of antibiotics for the treatment of IPN.

**AIM**

A systematic review was taken to evaluate the efficacy of local infusion of antibacterial agents to the site of infection in addition to systemic treatment after endoscopic drainage to resolve the infection and decrease the need for necrosectomy in patients with walled-off infected pancreatic necrosis.

**MATERIALS AND METHODS**

A systematic review was carried out in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [15]. An analysis of the medical literature sources that contain information on the treatment of infected wall-off necrosis (WON) with local antibiotics was performed independently by our team of gastroenterologists and surgeons. The databases included the National Library of Medicine (MEDLINE), Web of Science, Cochrane Library, and Google Scholar. Standardized terms for population and intervention themes in each database were found using the corresponding topic headings search tool. Based on the predefined review question, free-text phrases were created. Search strategy was: «infected» [All Fields] AND «walled» [All Fields] AND «off» [All Fields] AND («pancreatitis, acute necrotizing» [MeSH Terms] OR «pancreatitis» [All Fields] AND «acute» [All Fields] AND «necrotizing» [All Fields]) OR «acute necrotizing pancreatitis» [All Fields] OR «pancreatic» [All Fields] AND «necrosis» [All Fields]) OR «pancreatic necrosis» [All Fields] AND local [All Fields] AND («anti-bacterial agents» [All Fields] OR «anti-bacterial agents» [MeSH Terms] OR «anti-bacterial» [All Fields] AND «agents» [All Fields] OR «anti-bacterial agents» [All Fields] OR «antibiotics» [All Fields]) AND «infusion» [All Fields]. Before data extraction and synthesis, we conducted a re-run of the literature search. In addition to the database search, we reviewed the literature lists inside selected articles. Any of the study designs were permitted. Studies published between 2007 and 2022 were considered. No language restrictions were applied.

**Selection Strategy and Data Extraction.**

All types of study designs and manuscripts, including articles, case reports, abstracts, editorials, reviews, and theses, were considered. To establish a selection of reports for full-text review, two reviewers independently evaluated all selected titles and abstracts. The full texts of potentially eligible studies were independently assessed for eligibility by the same two authors. A third reviewer decided on any conflicts. The data extraction was performed based on a template recommended by the Cochrane Effective Practice and Organization of Care group. Data extracted from the articles included: general study information, design, setting, participant and intervention characteristics, data collection methods, and outcomes of interest for each group. All discrepancies were addressed by discussion. A meta-analysis was not conducted owing to the limited number of included manuscripts and variability of study design.

**Eligibility Criteria.**

Studies included in this review should have met the following criteria:

- Participants were adults (over 18 years) diagnosed with acute pancreatitis and stratified based on the Atlanta criteria with the documented infected WON and received systemic AB treatment before intervention.
- The intervention performed was endoscopic transmural drainage with local administration of antibiotics.
- Studies with a control group should include patients receiving standardized treatment without local antibiotics.
- There should be clinical and/or microbiological evaluation of effectiveness of treatment methods included in the outcomes of the study.

**Study Quality Assessment.**

For each article, the risk of bias was analyzed independently by two authors using the Newcastle-Ottawa Scale (NOS) for cohort studies [16] and the Joanna Briggs Institute (JBI) critical appraisal tool for case reports [17]. The NOS evaluates study quality in three domains: selection, comparability, and outcome, and assigns scores of 4, 2, and 3 points (maximum) for each domain, respectively, for a total maximum score of 9. If the total NOS score for a study was 7, it was judged to be of good quality. JBI critical appraisal tool was used for case reports. A checklist of 8 questions for case reports was used to assess bias. Each article is evaluated overall to determine whether the risk of bias is low, high, or uncertain. We regarded a low risk of bias if the «yes» responses were more than 50 %, a high risk of bias if the «no» answers were more than 50 %, and an uncertain risk of bias if the «unclear» answers were 50 %.
Outcomes of Interest.

The primary outcome was the results of the microbiological culture of samples obtained from the WON before and after the intervention. The secondary outcomes were the percentage of patients requiring necrosectomy and mortality.

RESULTS

The PRISMA flow diagram is shown in Figure 1. A total of 3447 records were identified through all sources. After deduplication with EndNote and Publish or Perish + Microsoft Excel, 2621 records were screened by titles and abstracts. After the removal of irrelevant records (n = 2609), the full text of 12 articles was evaluated for eligibility. Of these, 8 articles were excluded based on the predefined inclusion and exclusion criteria. No additional records were identified through a re-run of database searching undertaken before the data extraction and synthesis. Four studies were finally included, two cohort studies [13, 18] and two single-case reports [19, 20].

![Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-analyses flow chart of study selection process. AP, acute pancreatitis. WON, walled-off necrosis.](image)

**Design and quality assessment of the included studies.**

The comparative assessment of cohort studies included in the review by NOS is represented in Table 1. Both cohort studies represented single-center study populations during four years of observations, which was evaluated as somewhat representative of the average population in the community. The nonexposed cohort has been drawn from the same community in both studies. The two studies have used the data from patients' clinical records during their hospital stay for ascertainment exposure. In the Danish study, researchers stated that only patients with confirmed infected WON at the first endoscopy or patients who developed infected WON at the second endoscopy were included in the study. Both studies evaluated the effect of local administration of antibiotics by microbial cultures. Both works assessed the outcome by reference to the medical records, and both papers used an adequate timeframe between cultures to obtain precise results. As soon as both studies evaluated the effects of the procedures in hospitalized patients, there was no risk of loss to follow-up. Lastly, obtaining 8 and 9 points of NOS defined the assessed reports as high-quality studies.

Single-case reports were assessed with the JBI critical appraisal tool. The questionnaire for quality assessment of case report studies is shown in Table 2.
### Design and quality assessment of the included cohort studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Selection</th>
<th>Representativeness of exposed cohort</th>
<th>Selection of non-exposed cohort</th>
<th>Ascertainment of exposure</th>
<th>Demonstration that outcome of interest was not present at start of study</th>
<th>Comparability</th>
<th>Adjust for the most important risk factors</th>
<th>Adjust for other risk factors</th>
<th>Outcome</th>
<th>Assessment of outcome</th>
<th>Follow-up length</th>
<th>Loss to follow-up rate</th>
<th>Total quality score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Werge et al., 2018</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>Lariño-Noia et al., 2020</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>8</td>
</tr>
</tbody>
</table>

### Risk of bias questionnaire for the included case report studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Question</th>
<th>Inoue et al., 2015</th>
<th>Binda et al., 2021</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Were patient’s demographic characteristics clearly described?</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Was the patient’s history clearly described and presented as a timeline?</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Was the current clinical condition of the patient on presentation clearly described?</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Were diagnostic tests or assessment methods and the results clearly described?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Was the intervention or treatment procedure clearly described?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Was the post-intervention clinical condition clearly described?</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Were adverse events (harms) or unanticipated events identified and described?</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Does the case report provide takeaway lessons?</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
For overall appraisal, both studies could be included in the review according to the eligibility criteria. Figure 2 depicts that both of case reports have a minimal risk of bias. In the report by Binda et al. [19], the type of bacteria and name of antibiotics used were not stated. Only in the question about adverse or unanticipated events the overall risk of bias occurred to be «unclear» due to the absence of adverse effects reported by Inoue et al. [20]. Furthermore, the subsequent cohort study reported by Werge et al. [18] stated the absence of complications using the same treatment.

Study characteristics.

The two single-cohort studies were conducted by Werge et al. [18] and Lariño-Noia et al. [13] and included 131 and 48 patients with infected WON, respectively. According to the Spanish group, the method they used was endoscopic transmural drainage (ETD) with continuous lavage and local continuous infusion of imipenem/cilastatin at a dose of 250/250 mg diluted in 260 mL of saline every 6 h while keeping the patient on systemic antibiotics (Visualization and primary manipulation carried out by Therapeutic linear echoendoscope 3780 UTK Pentax Europe GmbH/ Ascendus, HITACHI, Medical Systems Europe). Local and systemic antibiotic therapy was modified, if necessary, based on antibiotic susceptibility of cultured germs from the infected WON. Irrigation and AB infusion was performed with Nasocystic single pigtail catheter 7–8.5 Fr. Fistula has been maintained by Double pigtail stents (Zimmon 7 Fr, Cook Medical). The association between microbial eradication and susceptibility to antibiotics was evaluated using univariate and multivariate regression analysis.

The Danish group used endoscopic transmural drainage and necrosectomy (EDTN) as a treatment method in their study (Visualization and primary manipulation carried out by Curved linear array echoendoscope Olympus GF-UCT140-AL5/ Aloka SSD-5000). Gentamycin early in the study and later associated with vancomycin were the empirical antibiotics used. The subsequent local antibiotic treatment was adjusted depending on the susceptibility of the germs. The authors used the method of continuous infusion and irrigation every 6 hours in their work. Irrigation and AB infusion was performed with Nasocystic catheter (7-Fr nasal biliary drainage set; Cook Medical). Fistula has been maintained by Double pigtail stents (Zimmon 7 Fr, Cook Medical). The association between microbial eradication and susceptibility to antibiotics was evaluated using univariate and multivariate regression analysis.

The study characteristics for included cohort studies may be found in table 3.

Characteristics of the included case reports are presented in table 4. In both cases, the authors used a different step-up approach, namely percutaneous endoscopic necrosectomy (PEN).
### Table 3

**Study characteristics for included single-arm cohort studies**

<table>
<thead>
<tr>
<th>Study author</th>
<th>Disease</th>
<th>Setting and period</th>
<th>Source population</th>
<th>Population size</th>
<th>Cases with the local instillation of AB</th>
<th>Procedure</th>
<th>Agents used locally</th>
<th>Treatment effect verification method</th>
<th>Adjusted variables</th>
<th>Main results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Werge et al., 2018</td>
<td>AP with infected WON</td>
<td>Denmark, 2012-2016</td>
<td>Single-center</td>
<td>131</td>
<td>81</td>
<td>ETDN</td>
<td>Gentamicin, Vancomycin, Amphotericin B</td>
<td>Microbiology (3 cultures)</td>
<td>Age and sex</td>
<td>Eradication effect between 1st and 2nd cultures (crude OR, 1.52; 95% CI, 0.73-3.17; p=0.26); 2nd and 3rd cultures (crude OR, 2.54; 95% CI, 1.25-5.18; p=0.01)</td>
</tr>
<tr>
<td>Lariño-Noia et al., 2020</td>
<td>AP with infected WON</td>
<td>Spain, 2015-2018</td>
<td>Single-center</td>
<td>1158</td>
<td>20</td>
<td>ETD</td>
<td>Imipenem/cilastatin, Gentamicin</td>
<td>Clinical and microbiology (3 cultures)</td>
<td>Age and sex</td>
<td>60% eradication, 45% clinical success, 10% mortality</td>
</tr>
</tbody>
</table>

### Table 4

**Study characteristics for included case reports**

<table>
<thead>
<tr>
<th>Study author</th>
<th>Disease</th>
<th>Type of infection</th>
<th>Preliminary treatment</th>
<th>Type of intervention</th>
<th>Agents used locally</th>
<th>Treatment effect verification method</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inoue et al., 2015</td>
<td>AP with infected WON</td>
<td>Candida albicans</td>
<td>Systematic AB</td>
<td>PEN</td>
<td>Amphotericin B</td>
<td>Clinical and microbiology</td>
<td>Patient’s condition improved subsequently after administration of antifungal agent and he was discharged 3 months after he was diagnosed with infected WON</td>
</tr>
<tr>
<td>Binda et al., 2021</td>
<td>AP with infected WON</td>
<td>Unknown</td>
<td>Systematic AB</td>
<td>PEN</td>
<td>Unknown AB and Amphotericin B</td>
<td>Clinical and imaging</td>
<td>Patient’s condition improved after 4 sessions of PEN with AB irrigation between sessions. A complete resolution of the necrosis was obtained 3 weeks after initial intervention</td>
</tr>
</tbody>
</table>
Outcomes.

Lariño-Noia et al. reported an eradication rate of the infected WON of 60%. The clinically evaluated success rate was 45%. In the other 45% of patients, EDTN was necessary. Mortality rate was 10%.

Werge et al. reported a crude odds ratio (OR) for eradication with local antibiotics of 1.52 (95% CI, 0.73–3.17; p=0.26) between the 1st and 2nd cultures. Between the 2nd and 3rd cultures, the use of local antibiotics was associated with a significant eradication of microbes (OR, 2.54; 95% CI, 1.25–5.18; p=0.01).

Both studies found that the majority of patients had a polymicrobial infection (74% and 56%, respectively), and most patients were infected with enterococci and other Gram-positive cocci. 47% and 30% of infected patients had fungal species cultured at the first culture in the Spanish and Danish studies, respectively. Frequent antibiotic resistance was found in both studies, being the resistance to penicillin the most frequent in the study of Lariño-Noia et al.

The results of the case reports agreed with the cohort studies, mentioning a complete recovery of the patients, absence of infectious agents at the following cultures [20], and absence of complications after using local antibacterial and/or antifungal treatment.

**DISCUSSION**

This systematic review shows the potential benefit of locally administered antibiotics for treating patients with infected WON. Our findings suggest that the adjunctive use of local antibiotics alongside systemic therapy enhances microbial eradication rates and reduces the necessity for necrosectomy.

The exact nature of bacteria causing IPN remains poorly understood. A retrospective review of 78 patients who underwent endoscopic drainage with necrosectomy for AP revealed a correlation between disease severity and the presence of IPN. Gram-positive Enterococcus species and Gram-negative Enterobacteria were commonly identified (45% and 42%, respectively), highlighting the diverse microbiota associated with these infections [21]. Similarly, our systematic review identified enterococci and other Gram-positive cocci as predominant pathogens in infected WON. These findings advocate for empiric antimicrobial therapy with broad-spectrum antibiotics, emphasizing the need for agents capable of penetrating necrotic tissue at inhibitory concentrations.

However, achieving satisfactory antibiotic levels in necrotic pancreatic tissue remains a significant challenge. While systemic antibiotics like imipenem, meropenem, fluoroquinolones, and metronidazole are recommended by the guidelines of the World Society of Emergency Surgery and the American College of Gastroenterology [6, 7, 22, 23], their efficacy is compromised by inadequate penetration into necrotic tissues. Bassi et al. reported that imipenem concentrations in pancreatic necrotic tissue often fail to exceed the MIC, leading to AB sensitivity issues [6].

González-López et al. propose local antibiotic delivery through a transmural nasocystic or percutaneous catheter, in conjunction with systemic treatment, suggesting this approach may enhance antibiotic concentrations in necrotic tissues, thereby improving therapy efficacy [14]. Their proposed Efficacy Factor (EF) formula, considering various parameters such as bacterial type, antibiotic diffusion coefficient, and concentration, indicates a rational correlation between concentration and diffusion capacity of antibiotics in the local necrotic environment, with imipenem showing high efficacy (EF = 0.9) [14].

The use of antibiotic-containing solutions for irrigation remains controversial. These solutions have shown promising results for treating thoracic empyema, peritonitis, prosthetic joint infection, and urinary bladder infection [24], as well as for the treatment of facial soft tissue infections [25]. However, the recommendations to use AB and antiseptics for surgical site irrigation remain conflicting because of their potential toxicity and ability to enhance bacterial drug resistance [26]. The lack of high-quality randomized studies hampers our understanding of the effectiveness and potential adverse effects of local antibiotic treatment.

Studies by Werge et al. and Lariño-Noia et al. provide insights into local antibiotic use. In the study by Werge et al., EDTN was performed in 131 patients with infected WON. The initial empiric local treatment was gentamycin, and if necessary, it was replaced by another antibiotic after obtaining cultural data. Irrigation of the necrosis was initiated at the index endoscopy and then performed 3–6 times a day with local infusion of a necessary AB. After local instillation of AB, neither was found in the blood serum samples, proving the absence of antibiotic toxicity in this study. The results of their study indicate that using local antibiotics may increase the eradication rate of microorganisms in WON, implying that local instillation may be a potential adjunct to systemic antibiotics for treating infected WON [18]. Meanwhile, the efficacy of the local use of amphotericin B was studied and showed promising results in the eradication of fungal species, as all fungal isolates treated with local amphotericin B were eradicated. The positive effect of local amphotericin B for treating fungal infections correlates with a case report by Inoue et al. [20].

Subsequently, Lariño-Noia et al. [13] performed another study by adding imipenem/cilastatin as the main line and gentamicin when indicated by susceptibility test to patients with infected WON who have failed systemic antibiotic treatment. Unlike in the previous group, the Spanish researchers used the method of continuous lavage and infusion of AB locally with an infusion rate
of 43.3 ml/h of the saline/AB solution every 6 hours. As a result, more than half of the patients who underwent this therapeutic strategy avoided necrosectomy.

The study has several limitations. Firstly, the small number of studies included limits the interpretation of the results. Secondly, the retrospective nature of the enrolled studies is associated with a small patient cohort in each instance. Thirdly, the different outcomes of each study limit the possibility of performing a meta-analysis. Fourthly, the absence of published works adhering to a standardized research protocol hampers a comprehensive understanding of the specific mechanisms contributing to the observed results. Nevertheless, our findings serve as a foundation for future controlled trials assessing the impact of local antibiotic administration in patients with infected WON.

CONCLUSIONS

In conclusion, local irrigation with AB and/or antifungals proved to be a potentially safe and effective adjunct to the standard systemic treatment in patients with infected WON. Introducing local instillation of AB in addition to systemic therapy may lead to reduction of the need for necrosectomy and showed significant improvement of microbial eradication rates.

Perspectives of further research. Further investigations on this topic are required to strengthen the evidence of obtained results.

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The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

COMPLIANCE WITH ETHICAL REQUIREMENTS

The article was prepared in compliance with all relevant ethical standards.

REFERENCES


Резюме

МІСЦЕВЕ АНТИБАКТЕРІАЛЬНЕ ЛІКУВАННЯ У ПАЦІЄНТІВ З ІНФІКОВАНИМ ПРИСІНКОВИМ НЕКРОЗОМ ПІДШЛУНКОВОЇ ЗАЛОЗИ: СИСТЕМАТИЧНИЙ ОГЛЯД

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Вступ. Системне антибактеріальне лікування у пацієнтів з інфікованим панкреатичним некрозом (ІПН) часто не приводить до усунення інфекції через порушення проникності в некротичні ділянки. Ендоскопічний поступовий підхід (step-up approach), заснований на ендоскопічному трансмуральному дренуванні з наступною, за необхідності, ендоскопічною некрозектомією, став стандартом лікування пацієнтів, які не реагують на системну терапію. Додаткове місцеве застосування антибактеріальних засобів може підвищити їх концентрацію в некротичних тканинах.

Мета. Оцінити ефективність додавання місцевих антибіотиків до системної терапії після ендоскопічного дренування у усуненні інфекції та зменшенні потреби в некрозектомії у пацієнтів з ІПН.

Матеріали та методи. Було проведено аналіз основних баз даних на наявність клінічних досліджень, що оцінюють ефективність місцевого застосування антибактеріальних засобів для лікування ІПН.

Результати. У роботу увійшло чотири дослідження: два когортних дослідження та два звіти про окремі клінічні випадки. У більшості хворих на ІПН спостерігалась полімікробна інфекція. Більше третини хворих додатково мали грибкову інфекцію. Місцеве застосування антибактеріальної терапії у пацієнтів з ІПН призвело до ерадикації бактеріальної та грибкової флори, що дозволило уникнути некрозектомії майже в половині випадків. Жодних місцевих або системних побічних ефектів при застосуванні цієї стратегії не повідомлялось.

Висновки. На сьогоденій день доказова база щодо ефективності застосування місцевої антибактеріальної терапії для лікування ІПН є недостатньою. Однак, місцеве та системне введення антибактеріальних засобів після ендоскопічного дренування може зменшити потребу в некрозектомії. Необхідні рандомізовані клінічні дослідження для оцінки впливу додавання місцевих антибактеріальних засобів до системної терапії на прогноз пацієнтів з ІПН.

Ключові слова: панкреатичний некроз, поступовий підхід, інфекція, локальна інфузія антибіотиків, некрозектомія.