Antibiotic prophylaxis is not protective in severe acute pancreatitis: a systematic review and meta-analysis

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**ABSTRACT**

**BACKGROUND:** The use of prophylactic systemic antibiotics to prevent infection and reduce mortality in severe acute pancreatitis (SAP) remains a contentious issue. We assessed the clinical outcome of patients with SAP treated with prophylactic antibiotics compared with that of patients not treated with antibiotics.

**METHODS:** We performed a systematic search of MEDLINE, EMBASE, and the Cochrane Central Register of Controlled Trials, using PubMed, Google Scholar, and Ovid as search engines without language restriction until the end of May 2008. We also manually searched the references of original/review articles and evaluated symposia proceedings, poster presentations, and abstracts from major gastrointestinal and surgical meetings. Relative risks were calculated for individual trials and data were pooled using a fixed-effects model. Relative risk (RR) reduction, absolute risk reduction, and number needed to treat were calculated and are reported with 95% confidence intervals.

**RESULTS:** Results were subjected to sensitivity analysis to determine heterogeneity among studies. We pooled 502 patients from 8 studies. Patient age ranged from 43 to 59 years, and length of stay ranged from 18 to 95 days. There were 253 patients with SAP who received prophylactic antibiotics, and 249 patients were randomized to the placebo arm. Overall, there was no protective effect of antibiotic treatment with respect to mortality (RR, .76; 95% confidence interval [CI], .49–1.16). With respect to morbidity, antibiotic prophylaxis did not protect against infected necrosis (RR, .79; 95% CI, .56–1.11) or surgical intervention (RR, .88; 95% CI, .65–1.20). There was, however, an apparent benefit in regards to nonpancreatic infections (RR, .60; 95% CI, .44–.82), with a RR reduction of 40% (95% CI, 18%–56%), absolute risk reduction of 15% (95% CI, 6%–23%), and number needed to treat of 7 (95% CI, 4–17).

**CONCLUSIONS:** Antibiotic prophylaxis of SAP does not reduce mortality or protect against infected necrosis, or frequency of surgical intervention.

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**KEYWORDS:** Antibiotic prophylaxis; Pancreatitis; Severe acute pancreatitis; Meta-analysis; RCTs

In the United States, 20% of patients admitted with acute pancreatitis develop severe acute pancreatitis (SAP)\textsuperscript{1} that may lead to a life-threatening condition associated with prolonged hospitalization, multiple surgical procedures, and death in some patients. SAP usually develops when parts of the pancreas become necrotic from the acute inflammation. Many of the complications are associated with the presence of this dead pancreatic tissue. SAP is a...
serious and life-threatening disease and requires intensive and aggressive management of multiple organ failure and severe infectious complications that can develop in these patients.

The International Symposium on Acute Pancreatitis described SAP as being associated with organ failure and/or local complications such as abscess, necrosis, or pseudocyst. SAP is diagnosed if any of the following 4 criteria are met: (1) organ failure with 1 or more of the following: shock (systolic blood pressure < 90 mm Hg), pulmonary insufficiency (partial arterial pressure of oxygen < 60 mm Hg), renal failure (serum creatinine level > 2 mg/dL after rehydration), or gastrointestinal tract bleeding (≥ 500 mL in 24 hours); (2) local complications such as necrosis, pseudocyst, or abscess; (3) at least 3 of Ranson’s criteria; or (4) at least 8 of the Acute Physiology and Chronic Health Care Evaluation II criteria. Mortality in patients with SAP can range from 10% in cases of sterile pancreatic necrosis to as high as 25% with infected necrosis. In contrast, mild acute pancreatitis has a mortality rate of less than 1%. As our understanding of the pathophysiology of SAP has improved through both animal and human studies, we have come to recognize that this disease process appears to comprise 2 stages. The initial phase is characterized by a systemic inflammatory response syndrome that can lead to multiorgan failure and ultimately death. The later phase comprises secondary bacterial infection of devitalized tissues primarily caused by gut-derived organisms. These invading organisms include both aerobic and anaerobic bacteria, often occurring in combination. Sterile necrosis can become infected with bacteria of gut origin in up to 70% of cases. In this context, the use of prophylactic antibiotics in preventing such pancreatic infection and the associated morbidity and mortality would seem compelling.

The use of prophylactic antibiotics to prevent infection and reduce mortality in pancreatitis was first evaluated in the 1970s. Findings from these studies were criticized for the inclusion of patients with mild forms of pancreatitis and the use of ampicillin, a drug with poor pancreatic penetration and a relatively narrow spectrum. Critics also have cited the increased risk of resistant organisms and fungal infections. There have since been multiple randomized controlled trials with different, more contemporary, antibiotics. Several systematic reviews both with and without meta-analysis have been conducted that have excluded various studies and have reported conflicting results, thus the issue remains contentious. In light of the continuing controversy, we performed a systematic literature review and meta-analysis of available randomized controlled trial (RCTs) in accordance with recommendations outlined by the Cochrane collaboration and the quality of reporting of meta-analyses guidelines. We hypothesized that patients who were administered antibiotics would show a lower incidence of infected necrosis and mortality than patients not receiving antibiotics.

Methods

Study selection

We conducted a search of MEDLINE, EMBASE (1966–May 2008), and the Cochrane Central Register of Controlled Trials, using PubMed and Ovid as search engines, in addition to Google Scholar. The search was limited to human studies and was without language restrictions. The following medical subject heading terms and text terms were used: “prophylactic antibiotic,” “severe acute pancreatitis,” “randomized controlled trial.” Boolean operators (“NOT,” “AND,” “OR”) also were used in succession to narrow and widen the search. To increase the number of hits using the Ovid search engine, we used the “explode” and “related article” functions. Based on the title and abstract, we either downloaded or requested full articles. Reference lists in these trials were checked to identify any other published or unpublished data. We hand-searched the references of review articles, evaluated symposia proceedings, poster presentations, and abstracts from major gastrointestinal and surgical meetings.

Inclusion criteria

Abstracts, full articles, and grey literature (symposia proceedings and poster presentations from major gastrointestinal and surgical meetings) that passed the primary screening, were retrieved and scrutinized for the presence of all of the following:

- All studies were RCTs.
- SAP was diagnosed with contrast-enhanced computed tomography and any of the following; Acute Physiology and Chronic Health Care Evaluation II, Imrie classification, and increased C-reactive protein levels greater than 120 mg/L.
- Necrosis was evaluated by contrast-enhanced computed tomography.
- Prophylactic antibiotics were administered via an intravenous route.
- Defined length of antibiotic treatment.
- Morbidity and mortality were measured objectively.
- If there were multiple publications of the same trial, only the most recent publication was considered for analysis.

Exclusion criteria

The exclusion criteria served as a primary screening procedure for excluding:

- Case reports, letters, editorials, comments, reviews, and abstracts with insufficient details to meet the inclusion criteria.
- Nonrandomized studies.
Data extraction

Data were abstracted by 3 independent reviewers (N.S.J., S.S.M., and S.R.I.). Each article was scrutinized to determine whether it met the predetermined inclusion and exclusion criteria. Data were abstracted independently by each reviewer using a standardized data collection form to increase the uniformity of data extraction and to reduce reporting bias. In the case of discrepancy, a consensus decision was made with the help of the senior author. Reviewers independently abstracted the following data from each report: first author, year of publication, institution, single-center/multicenter study, number of patients in the treatment and control arms, etiologies, length of follow-up period, name of antibiotic, dose and timing of antibiotic administration, incidence of nonpancreatic infections, incidence of surgery, incidence of mortality, method of data analysis (intention to treat or per protocol), and the method of diagnosing complications. Corresponding authors were contacted for any missing data points. Disagreements over values or analysis were resolved by discussion.

Assessment of study quality

Once a study was selected for inclusion, 3 authors (N.S.J., S.S.M., and S.R.I.) independently rated the quality of each randomized trial using the Jadad et al16 scale, a validated instrument for assessing the quality of randomized studies. This is a 5-question scale assessing the following: (1) the study is randomized, (2) the study is double-blinded, (3) withdrawals are described, (4) randomization allocation is explained adequately, and (5) blindness is described adequately. Scores range from 1 to 5, with a higher score indicating higher quality. We assigned an arbitrary score of less than 3 to indicate a lower study quality, whereas studies achieving a rating of 3 or more points were considered of higher quality and were used as part of the sensitivity analysis.

Statistical analysis

Meta-analysis was performed according to the quality of reporting of meta-analyses guidelines17 and the recommendations of the Cochrane collaboration.18 The effect measures estimated were relative risk (RR) for dichotomous data, which we report with 95% confidence intervals (CIs). The RR indicates the risk of an individual who received prophylactic antibiotics developing a wound infection compared with the risk of an individual not receiving prophylactic antibiotics.

Relative risk reduction (RRR), absolute risk reduction (ARR), and number needed to treat (NNT) were calculated to assess if the relative risk was clinically important. The RRR represents the proportional reduction in rates of outcomes between experimental and control participants in a trial. The ARR signifies the absolute difference in outcome rates between the prophylactic antibiotic and control groups. The NNT is the reciprocal of the ARR and denotes the number of patients that would need to be treated to prevent 1 adverse event (eg, an infection).

The RR from the separate studies were combined according to a fixed-effects model (Mantel-Haenszel methods),19,20 which assumes the presence of homogeneity between individual trials. With this model, trials are considered samples from the same population of patients. In effect, the smaller trials are random samples from 1 large common trial.

Analyses were conducted using Comprehensive Meta-Analysis software (version 2.0; Biostat, Englewood, NJ) and Review Manager (version 4.2.8, Plone Foundation).

Validity assessment

We tested for heterogeneity among studies using the I² test. For the I² test, a calculation of greater than 50% reflects statistical significance for heterogeneity.21,22 When heterogeneity was identified, we made every attempt to investigate the source. We used both qualitative and quantitative methods to detect for the presence of publication bias. We initially constructed funnel plots to visually inspect for the presence of publication bias23,24 and then performed Egger et al25 and Begg and Mazumdar26 tests to quantitatively assess for the presence of publication bias. In addition, sensitivity analyses were undertaken to evaluate the heterogeneity of the relationship between the type and dose of antibiotic, concurrent antibiotic therapy, length of follow-up period, and study quality (≥3 points per the Jadad et al16 scale).

Results

Study characteristics

Our initial search yielded 367 literature citations (Fig. 1). Of these, 312 citations were excluded by primarily review-
ing the full-text article because they were irrelevant to pancreatitis (n = 200) or to antibiotic use (n = 112). An additional 8 meta-analyses, 3 earlier RCTs, 3 antibiotic versus antibiotic RCTs, 1 study on timing of prophylactic antibiotics, 17 review articles, 1 editorial, and 1 letter were excluded, leaving 8 RCTs eligible for meta-analysis.27–34

Of the 8 included studies (Table 1), most RCTs had been performed in medical centers in Europe. Six studies were single-blinded,29–34 whereas 2 were double-blinded.27,28 Four studies used intravenous β-lactam–based prophylaxis,27,29–31 2 used intravenous quinolone-based prophylaxis,27,28 and another used cephalosporin prophylaxis.32 In yet another study, quinolone-based prophylaxis was used as a first choice and β-lactam–based prophylaxis was reserved for patients allergic to quinolones.34

**Patients and antibiotic treatment**

A total of 502 patients were pooled from individual trials. A total of 253 patients were randomized to the antibiotic prophylaxis group and 249 were randomized to the placebo arm. Patient age ranged from 43 to 59 years. Fifty-six percent of patients had alcoholic pancreatitis, the leading cause of SAP, followed by biliary pancreatitis (24%) and other causes (20%). The duration of antibiotic treatment ranged from 5 to 21 days. The length of hospital stay ranged from 18 to 95 days. Data regarding mortality, surgical intervention, rates of pancreatic necrosis, and nonpancreatic infection are shown in Table 1.27,29–31 We presumed “non-pancreatic infections” to be infections of other organ systems and/or multiorgan infections; however, most studies did not specify the actual infected organ system. Therefore, we accepted the number they provided for this category. Adverse events of antibiotic usage were not stated explicitly in the included studies.

Crude outcome rates are presented in Table 2. By using a fixed-effect model to evaluate mortality, antibiotic prophylaxis resulted in a RR of .76 (95% CI, .49–1.16; I² = 8.8%); indicating homogeneity among studies) (Fig. 2).

**Sensitivity analysis**

Sensitivity analysis was conducted to determine whether infected necrosis, surgical interventions, nonpancreatic infections, class of antibiotic, or study quality (Jadad et al16 scale > 3) had a significant effect on the strength and direction of the results.

**Infected necrosis.** Seven studies27–30,32–34 evaluated infected necrosis in patients (n = 429; antibiotics, 43 of 217; placebo, 53 of 212) and found no benefit of antibiotics (RR, .79; 95% CI, .56–1.11; I² = 30.6%).

**Surgical interventions.** Seven studies27–32,34 evaluated the need for surgical intervention in SAP (n = 476; antibiotics, 55 of 240; placebo, 60 of 236) and collectively did not find a beneficial effect of antibiotics (RR, .88; 95% CI, .65–1.20; I² = 0%).

**Nonpancreatic infections.** Six studies27–31,33 reported patients who had nonpancreatic infections in both study groups (n = 407; antibiotics, 45 of 206; placebo, 71 of 201) and collectively did not find a beneficial effect of antibiotics (RR, .88; 95% CI, .65–1.20; I² = 50.1) with a RRR of 40% (95% CI, 18%–56%; I² = 50.1%), an ARR of 15% (95% CI, 6%–23%), and a NNT of 7 (95% CI, 4–17).

**Type of antibiotics**

**β-lactam.** Four studies27–31 used β-lactams for treatment.

**Mortality.** Four studies that used only β-lactams and evaluated mortality (n = 305; antibiotics, 18 of 152; placebo, 22 of 153) found no benefit to the use of prophylactic antibiotics (RR, .81; 95% CI, .41–1.60; I² = 0%).

**Infected necrosis.** Studies27,29,30 that used β-lactams and evaluated infected necrosis (n = 232; antibiotics, 15 of 116; placebo, 22 of 116) found no benefit to the use of prophylactic antibiotics (RR, .64; 95% CI, .30–1.37; I² = 61.1).

**Surgical interventions.** Four studies27,29–31 that used β-lactams and evaluated surgical intervention (n = 305; antibiotics, 30 of 152; placebo, 29 of 153) found no beneficial effect (RR, .99; 95% CI .55–1.79; I² = 0%).

**Nonpancreatic infections.** Four studies27,29–31 that used β-lactams and evaluated nonpancreatic infections (n = 305; antibiotics, 29 of 152; placebo, 53 of 153) found a beneficial effect (RR, .38; 95% CI, .22–.68; I² = 67.0%) with a RRR of 62% (95% CI, 32–78), an ARR of 12% (95% CI, 3–20), and a NNT of 8 (95% CI, 5–33).

**Higher-quality studies.** Five studies27–30,31,32 scored higher than 3 on the Jadad et al16 scale and thus were considered of high quality.

**Mortality.** All 5 studies evaluated mortality in SAP (n = 367; antibiotics, 19 of 182; placebo, 29 of 185) and found no benefit of prophylactic antibiotics (RR, .67; 95% CI, .39–1.15; I² = 0%).

**Infected necrosis.** Four studies27–29,32 evaluated infected necrosis in SAP (n = 294; antibiotics, 26 of 146; placebo, 29 of 148) and found no benefit of prophylactic antibiotics (RR, .90; 95% CI, .56–1.44; I² = 16.5).

**Surgical intervention.** All 5 studies27–30,31,32 evaluated surgical intervention in SAP (n = 367; antibiotics, 35 of 182; placebo, 38 of 185) and found no benefit of prophylactic antibiotics (RR, .91; 95% CI, .61–1.38; I² = 16.5).

**Nonpancreatic infections.** Four studies27–29,31 evaluated nonpancreatic infections in SAP (n = 307; antibiotics, 35 of 152; placebo, 49 of 155) and found no benefit of prophylactic antibiotics (RR, .70; 95% CI, .49–1.00; I² = 57.4).
<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>Institution</th>
<th>Blinded</th>
<th>Inclusion criteria</th>
<th>Duration, d</th>
<th>Antibiotic type</th>
<th>Most common etiology</th>
<th>Hospital length of stay, d</th>
<th>Infected necrosis, n</th>
<th>Surgery, n</th>
<th>Nonpancreatic infections, n</th>
<th>Mortality, n</th>
<th>Quality score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pederzoli et al&lt;sup&gt;30&lt;/sup&gt;</td>
<td>1993</td>
<td>Multicenter</td>
<td>Number</td>
<td>CECT</td>
<td>14</td>
<td>Imipenem .5 g for 14 d</td>
<td>Alcohol</td>
<td>NR</td>
<td>41</td>
<td>5</td>
<td>12</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Sainio et al&lt;sup&gt;32&lt;/sup&gt;</td>
<td>1995</td>
<td>Single center</td>
<td>Number</td>
<td>CECT and CRP &gt; 120 mg/L</td>
<td>&gt;14</td>
<td>Cefuroxime 1.5 g every day</td>
<td>Placebo</td>
<td>Alcohol</td>
<td>NR</td>
<td>33</td>
<td>10</td>
<td>11</td>
<td>16</td>
</tr>
<tr>
<td>Schwarz et al&lt;sup&gt;33&lt;/sup&gt;</td>
<td>1997</td>
<td>Single center</td>
<td>Number</td>
<td>CECT</td>
<td>10</td>
<td>Ofloxacin 200 mg twice a day and metronidazole 500 mg twice a day</td>
<td>Placebo</td>
<td>Alcohol</td>
<td>NR</td>
<td>43.8</td>
<td>12</td>
<td>14</td>
<td>NR</td>
</tr>
<tr>
<td>Nordback et al&lt;sup&gt;29&lt;/sup&gt;</td>
<td>2001</td>
<td>Single center</td>
<td>Number</td>
<td>CECT and CRP &gt; 150 mg/L</td>
<td>&gt;5</td>
<td>Imipenem 1 g and cilastin</td>
<td>Placebo</td>
<td>Alcohol</td>
<td>NR</td>
<td>20 + 13</td>
<td>13</td>
<td>7</td>
<td>NR</td>
</tr>
<tr>
<td>Spicak et al&lt;sup&gt;34&lt;/sup&gt;</td>
<td>2004</td>
<td>Multicenter</td>
<td>Number</td>
<td>CECT</td>
<td>10</td>
<td>Ciprofloxacin 200 mg every 8 hours or meropenem 500 mg every 8 hours</td>
<td>Placebo</td>
<td>Alcohol</td>
<td>Biliary</td>
<td>20 + 13</td>
<td>33</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Isenmann et al&lt;sup&gt;28&lt;/sup&gt;</td>
<td>2004</td>
<td>Multicenter</td>
<td>Double-blinded</td>
<td>CECT and CRP &gt; 150 mg/L</td>
<td>21</td>
<td>Ciprofloxacin 800 mg every day and metronidazole 1,000 mg every day</td>
<td>Placebo</td>
<td>Biliary</td>
<td>Alcohol</td>
<td>35.5 (19.3–21.7)</td>
<td>18</td>
<td>7</td>
<td>11</td>
</tr>
<tr>
<td>Dellinger et al&lt;sup&gt;27&lt;/sup&gt;</td>
<td>2007</td>
<td>Multicenter</td>
<td>Double-blinded</td>
<td>CECT ± MOD score &gt; 2 or CRP &gt; 120 mg/L</td>
<td>21</td>
<td>Meropenem 1 g intravenously every 8 hours</td>
<td>Placebo</td>
<td>Alcohol</td>
<td>Biliary</td>
<td>18 (3–129)</td>
<td>35</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>Rokke et al&lt;sup&gt;31&lt;/sup&gt;</td>
<td>2007</td>
<td>Multicenter</td>
<td>Number</td>
<td>CECT and CRP &gt; 120 mg/L</td>
<td>5–7</td>
<td>Imipenem .5 g intravenously 3 times a day</td>
<td>Placebo</td>
<td>Biliary</td>
<td>Alcohol</td>
<td>18 (6–71)</td>
<td>36</td>
<td>10</td>
<td>24</td>
</tr>
</tbody>
</table>

CECT = contrast-enhanced computed tomography; CRP = C-reactive protein; NR = not reported.
Fig. 3 shows the funnel plots of high-quality studies for mortality. All high-quality RCTs were within the 95% CI (the inverted funnel), indicating that they were similar with respect to both precision and effect. The absence of RCTs to the right of the effect line and below a standard error of .05 suggested the presence of publication bias. The presence of publication bias was shown quantitatively by both the Egger et al\textsuperscript{25} test ($P = .031$) and the Begg and Mazumdar\textsuperscript{26} test ($P = .027$).

**Comments**

The role of systemic antibiotics in the management of acute pancreatitis remains controversial. The development of complications such as infected pancreatic necrosis, abscesses, and infected pseudocysts, herald the development of a deteriorating disease process that is associated with considerable morbidity and mortality. The use of appropriate antibiotics in the setting of SAP would appear to be a logical choice in the management of this condition. However, most of the RCTs conducted thus far have failed to show the benefit of antibiotics. The present meta-analysis does not support the use of prophylactic antibiotics to reduce the frequency of surgical intervention, infected necrosis, or mortality in patients with SAP. They may, however, be beneficial in protecting against the development of non-pancreatic infections, the mechanisms of which are not understood. This does need to be weighed against the significant adverse events associated with antibiotics, including increased bacterial resistance and fungal infections.

The strengths of the present meta-analysis include the lack of significant heterogeneity in overall mortality, infected necrosis, and surgical interventions.

Guidelines and consensus statements have advocated the prompt and judicious use of antibiotic prophylaxis in the setting of SAP.\textsuperscript{35,36} Evidence indicates that these groups of patients benefit from such practices in terms of infected necrosis, but without any corresponding improvements in mortality.\textsuperscript{5,35,36}

The present study findings are consistent with those of the 3 earliest reports in the 1970s. Since the oral presentation of our initial meta-analysis, which suggested a protective effect of antibiotics in SAP, Dellinger et al\textsuperscript{27} and Rokke et al\textsuperscript{31} have published RCTs with 173 patients in which there was no association between prophylactic antibiotic use and the rate of infected necrosis or mortality. After pooling the patients from all of these studies, our results are consistent with those of Bai et al.\textsuperscript{9} Several other meta-analyses

**Table 2**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Antibiotic prophylaxis (%)</th>
<th>Control (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>Surgical intervention</td>
<td>23</td>
<td>25</td>
</tr>
<tr>
<td>Infected necrosis</td>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td>Nonpancreatic infections</td>
<td>22</td>
<td>35</td>
</tr>
</tbody>
</table>

**Figure 2**

Meta-analysis of RCTs on prophylactic antibiotics versus placebo/no intervention on mortality.

**Figure 3** Funnel plot of high-quality studies (Jadad et al\textsuperscript{16} score > 3). The vertical axis represents the line of no effect with the horizontal axis representing log of RR. The 95% CI is represented by the diagonal lines. The circles represent each study.
indicated early antibiotic prophylaxis to be beneficial, however, these were published between 1998 and 2003. Since then there have been 3 further RCTs, 2 of which are the only double-blind, placebo-controlled trials to date on the subject.

There were several limitations observed in this study that accounted for the significant heterogeneity observed in the analysis of nonpancreatic infections as well as β-lactam prophylaxis of infected necrosis. Some of these limitations were inherent in the primary study design such as inclusion criteria, duration and dosing of antibiotics, assessment of severity of disease, nutritional support, and resuscitative measures. Other notable limitations included the relatively small number of patients in each individual study, different outcome measurements, and the inclusion of low-quality studies. In addition, the inclusion of unblinded studies constrains the findings because these patients could have received surgical interventions when investigators realized that they were not receiving antibiotics. Several of the sensitivity analyses are constrained by the limited number of studies, small sample sizes, and wide standard deviations, which in turn limit the confidence in drawing conclusions as reflected in the wide CIs. Ideally, we would have liked to conduct sensitivity analyses based on etiology as well, but sufficient data were not available on individual patients.

Concerns over the increasing prevalence of multidrug-resistant bacterial and fungal infections in the setting of often prolonged prophylactic antibiotic use in SAP have been raised because this is associated with poor outcome. We could not evaluate the incidence of such complications because individual patient data were not available.

The present meta-analysis presents conclusive evidence that antibiotic prophylaxis for SAP is not beneficial in protecting against infected necrosis, surgical intervention, or reducing mortality. If there is a limited benefit, it is in preventing nonpancreatic infections.

References