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# Complicated Intraabdominal Infections; Epidemiology of Microorganisms, Resistance Profiles and Risk Factors Associated with Mortality

# Komplike İntraabdominal Enfeksiyonlar; Mikroorganizmaların Epidemiyolojisi, Direnç Profilleri ve Mortalite ile İlişkili Risk Faktörleri

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## ABSTRACT

**AIM:** The threat of antimicrobial resistance has been identified as one of the major challenges in the management of complicated intra-abdominal infections(cIAIs). In this study, we aimed to describe the clinical, microbiological and resistance profiles of complicated intra-abdominal infections and to assess the risk factors related to resistance and mortality.

**MATERIAL AND METHOD:** Seventy-nine patients undergoing surgery or interventional drainage for cIAIs with a positive microbiological culture were documented.

**RESULTS:** Among these patients 79,7% were affected by health care associated IAIs while remaining 20,3% cases were identified as cIAI in the community. In 79 cases, 143 microorganisms were isolated and the leading microorganism was E.coli (34.9%) followed by Enterococcus spp. (17.4%). Among Enterobacteriaceae (n:96), 53.6% of the strains had ESBL and 36.8% were Multi Drug Resistant (MDR) bacteria. The overall mortality rate was 22.8%. According to univariate analysis, the use of broad spectrum antibiotics between initial intervention and re-operation was a significant risk factor for presence of ESBL. By multivariate analysis of the data; isolation of MDR bacteria, Enterococcus spp as an etiologic agent and presence of chronic obstructive pulmonary disease were statistically significant indicators for mortality.

**CONCLUSION:** These data indicate that local community and nosocomial resistance patterns should guide empiric antimicrobial therapy. To have the efficient data for resistance patterns, culture of the materials should not be neglected in either hospital or community acquired IAIs.Due to the increase in the prevalence of ESBL positive and MDR bacteria, demonstration of the epidemiological data in populations and each hospital is crucially important for accurate selection of initial empirical antibiotherapy

**Anahtar Kelimeler:** Intraabdominal infection, resistance, mortality

## ÖZET

**AMAÇ:** Antimikrobiyal direnç tehdidi, komplike intraabdominal enfeksiyonların(cIAI) tedavisindeki en büyük zorluklardan biridir.Bu çalışmada komplike intraabdominal enfeksiyonların klinik ve mikrobiyolojik özelliklerin, etkenlerin direnç profillerinin tanımlanması, direnç ve mortalite ile ilişkili risk faktörlerinin belirlenmesi amaçlandı.

**GEREÇ VE YÖNTEM:** Komplike intraabdominal enfeksiyon tanısıyla takip edilen, perkutan drenaj ya da açık cerrahi ile alınan mikrobiyolojik kültürleri pozitif olan 79 hasta dökümente edildi.

**BULGULAR:** Hastaların %79,7'si sağlık hizmeti ilşkili intraabdominal enfeksiyon ve geri kalan %20,3'ü toplumda edinilmiş intraabdominal enfeksiyon olarak sınıflandırıldı. 143 mikroorganizma izole edildi. En sık izole edilen mikroorganizma E.coli (34.9%), sonrasında Enterococcus spp.(17.4%) olduğu görüldü. Enterobacteriaceae (n:96) türleri içerisinde %53.6 ESBL pozitif ve %36.8 çoklu ilaca dirençli (MDR) bakteri olarak saptandı. Mortalite oranı %22.8'di. Tek değişkenli analizlere göre iki cerrahi girişim arasında geniş spektrumlu antibiyotiklerin kullanımı ESBL varlığı için risk faktörüydü. Verilerin çok değişkenli analizlerine göre ise MDR bakteri izolasyonu, etkenin Enterococcus spp. olması ve kronik obstrüktif akciğer hastalığı varlığı istatistiksel olarak anlamlı mortalite belirleyicisiydi.

**SONUÇ:** Bu veriler bölgesel toplumsal ve nozokomiyal direnç paternlerinin, ampirik antibiyotik tedavisini yönlendirmesi gerektiğine işaret etmektedir. Yeterli verinin sağlanabilmesi için toplum kökenli ya da sağlık hizmeti ilişkili intraabdominal enfeksiyonlarda kültür alınmalıdır. ESBL pozitif ve MDR bakteri sıklığındaki artış nedeniyle, toplumda ve hastanede epidemiyolojik verilerin bilinmesi başlangıç ampirik antibiyotik tedavisinin seçiminde önemlidir.

**Anahtar Kelimeler**: İntraabdominal enfeksiyon, direnç, mortalite

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## INTRODUCTION

Treating complicated intraabdominal infections (cIAIs) is an ongoing challenge for clinicians because of the high complication risk and increased risk of death in severely ill patients. Complicated intra-abdominal infections are defined as infections that extends beyond the hollow viscus of origin into the peritoneal space and is associated with either abscess formation or peritonitis. Uncomplicated infection involves intramural inflammation of the gastrointestinal tract and has a substantial probability of progressing to complicated infection if not adequately treated.[1] Prompt diagnosis, adequate resuscitation, appropriate systemic antibacterial therapy, early and effective source control, reassessment of the clinical response, and appropriate adjustment of the management strategy are paramount for the successful treatment of cIAIs.[2]

Knowledge of the patient's risk for isolation of resistant pathogens, such as; immunodeficiency and prolonged antibacterial exposure and the source and severity of the infection are essential. Following this, treatment should start with the most appropriate regimen immediately. Healthcare-associated intraabdominal infections (HCA-IAIs) are commonly caused by more resistant bacteria, although the resistance level is also significant in community-acquired infections. The rapid spread of multi-drug resistant (MDR) and extended-spectrum beta-lactamases (ESBL) that have produced gram-negative bacteria is a major threat to antimicrobial therapy. Detecting and monitoring any change in the resistance patterns of pathogens, locally and regionally, plays a crucial role in managing antimicrobial therapy.[3]

Therefore, we documented the clinical and microbiological profiles of cIAIs at our institution to describe the pathogens of infection and the resistance patterns, to obtain data that could lead to better empirical treatment and therapeutic strategies for selecting appropriate antibiotics based on local resistance/susceptibility. We also aimed to investigate risk factors related to mortality and assess the prognostic features linked to resistant pathogens causing cIAIs.

## MATERIAL AND METHOD

Patients hospitalized at the emergency surgery clinic and surgical intensive care unit of a tertiary hospital between January and December 2015, who had surgery or percutaneous drainage for cIAIs and whose tests resulted in positive microbiological culture were included in the study. Their medical charts and microbial profiles were reviewed retrospectively.

Cases were classified into two groups: "community onset-complicated intra-abdominal infections (CO-cIAIs)" and "HCA-IAIs". Patients admitted to the hospital for more than two days at the time of infection and patients with post-operative infections were placed in the latter group. Despite applying from community because of inadequate and reliable anamnesis regarding the previous 12 months, the remaining cases could not be classified as "community-acquired". Therefore, a new category, "community onset-complicated intra-abdominal infections (CO-cIAIs)" was suggested.

The following data were collected from patients' medical records: demographic features; age and gender, initial diagnosis which included the following; post-operative intraabdominal abscess, colon anastomosis leakage, perforated appendicitis, gastric anastomosis leakage, gallbladder perforation, small intestine perforation, colon perforation, gastric anastomosis leakage, peptic ulcer perforation comorbid diseases; diabetes mellitus (DM), chronic obstructive pulmonary disease (COPD), chronic renal failure (CRF), immunosuppressive therapy, cardiovascular disease, malignancy and hypertension (HT).

The categorization of surgical interventions was based on the operating surgeons' decisions and divided into four classes: clean, clean-contaminated, contaminated, and dirty. Surgical wound classification was defined as the National Academy of Sciences.[4] The operations' type and timing were open or laparoscopic and urgent or elective, respectively.

Data regarding microbiologic examination of the liquid aspirated during the operation or postoperative period and the antimicrobial susceptibility test results of infecting microorganisms were collected. The infection was considered monomicrobial or polymicrobial according to the number and type of isolated microorganisms.

Along with examination of isolated Enterobacterales for ESBL, gram-negative pathogens resistant to three or more different classes of antibiotics through cephalosporins, aminoglycosides, fluoroquinolones, carbapenems, and penicillin were accepted as MDR.

The following risk factors that may be related to the development of cIAIs with ESBL or MDR gram-negative pathogens were recorded: hospitalization occurring within 12 months before the first operation, having been prescribed antibiotics within the last seven days and having taken antibiotics in the period between two interventions for patients who were re-operated.

Mortality refers to any cause of death occurring at a hospital. The relationship between mortality and all the parameters mentioned above (demographic features, underlying diseases, isolation of resistant microorganisms, community-onset infection or healthcare-associated infection) was statistically determined.

### Statistical analysis

SPSS for Windows 11.5 was used to gather and analyze the collected data. The Kolmogorov–Smirnov test was chosen to ensure the distribution of intermittent numerical variables was close to normal. Descriptive statistics were shown as having a mean ± standard deviation or median (minimum–maximum) for intermittent numerical variables, and the percentage (%) and number of cases were given for categorical variables. To assess the significant difference between the mean values of groups and compare categorical variables between different groups, the Student's t-test and Pearson's chi-square or Fisher's exact chi-square tests were preferred. To investigate the co-effects of all possible risk factors that were effective or thought to be effective on mortality as a result of univariate statistical analysis, multivariate analysis was carried out using stepwise logistic regression analysis. Variables identified as $p < 0.25$ as a result of univariate statistical analysis were added to multivariate models as candidate risk factors. Finally, adjusted odds ratios and their 95% confidence intervals for each variable were provided. Statistical significance was defined as $p < 0.05$.

Ethical approval was obtained from Ankara Numune Training and Education Hospital Clinical Research Ethics Committee (Permission Date 05.09.2013, Permission number E-724.01).

## RESULTS

Among the 79 cIAI cases, 16 were CO-cIAIs (20.3%) and 63 healthcare-associated (79.7%) infections were observed. In most cases (42 out of 79 patients; 53.2%), more than one species were cultured (polymicrobial) without any statistically significant difference between the CO-cIAIs and the HCA-IAIs groups ($p = 0.402$). The overall number of bacteria cultured from abdominal swabs totaled 143. In CO-cIAIs and HCA-IAIs groups, at a frequency of 50 strains, Escherichia coli was the most common microorganism, followed by 25 Enterococcus spp. strains. The distribution of other isolated microorganisms was also similar among the two groups. Although the Pseudomonas species were more common in the postoperative cases, the difference was not significant. A complete overview of the cultured microorganisms is presented in Table 1.

Table 1: Distribution of microorganisms isolated from peritoneal fluid in community onset complicated intra-abdominal infections (CO-cIAIs) and healthcare-associated- intra-abdominal infections (HCA-IAIs).

| | CI-cIAI (n: 32) | HCA-IAI (n: 111) | p |
|---|---|---|---|
| Gram-negative | | | |
| *Escherichia coli* | 12 | 38 | 0.733 |
| *Klebsiella* spp. | 3 | 14 | 0.764 |
| *Pseudomonas* spp. | 2 | 6 | 1.000 |
| *Acinetobacter* spp. | 0 | 12 | 0.068 |
| Other *Enterobacterales* | 1 | 8 | 0.684 |
| Gram-positive | | | |
| *Streptococcus* spp. | 3 | 6 | 0.419 |
| *Enterococcus* spp. | 8 | 17 | 0.204 |
| *Staphylococcus* spp. | 2 | 5 | 0.653 |
| *Candida* spp. | 1 | 5 | 1.000 |

CO-cIAIs:Community onset-complicated intra-abdominal infections, HCA-IAI: Healthcare-associated- intra-abdominal infections, spp: species

Among Enterobacterales (n: 96), 53% of the strains had ESBL and 36.8% were detected as MDR. Regarding CO-cIAIs, the number of ESBL and MDR E.coli strains were 5/12 and 3/12, respectively. In concordance with these results, the resistance rates were also high for the Klebsiella species (ESBL: 3/3, MDR: 1/3). No MDR Acinetobacter baumannii strains were found in the community onset patients. Regarding ESBL and MDR, positively observed in the E.coli and Klebsiella spp. strains, there was no difference between CO-cIAIs and HCA-IAIs

Table 2: Resistance rates of gram-negative bacteria in the community onset complicated intra-abdominal infections(CO-cIAIs) and healthcare-associated- intra-abdominal infections (HCA-IAIs).

| Gram-negative | CI-cIAIs (n: 17) | HCA-IAIs (n: 78) | P |
|---|---|---|---|
| *Escherichia coli* | 12 | 38 | 0.102 |
| ESBL (+) | 5 | 25 | 0.832 |
| MDR (+) | 3 | 9 | 0.445 |
| *Klebsiella* spp. | 3 | 14 | 1.000 |
| ESBL (+) | 3 | 9 | 0.445 |
| MDR (+) | 1 | 7 | 1.000 |
| *Pseudomonas* spp. | 2 | 6 | 0.631 |
| ESBL (+) | 1 | 2 | 0.450 |
| MDR (+) | 0 | 1 | 1.000 |
| *Acinetobacter* spp. | 0 | 12 | 0.116 |
| MDR (+) | 0 | 12 | 0.116 |
| Other Enterobacterales | 1 | 8 | 1.000 |
| ESBL (+) | 1 | 5 | 1.000 |
| MDR (+) | 1 | 1 | 0.327 |

CO-cIAIs: Community onset-complicated intra-abdominal infections, HCA-IAI: Healthcare-associated- intra-abdominal infections, ESBL: Extended-spectrum beta-lactamases, MDR: Multi-drug resistant, spp:species

As for the risk factors, 12 patients had a hospitalization history before the first operation. Before the initial surgery, only four patients disclosed information about antibiotic usage; however, 49 patients had antibiotic therapy between the first and subsequent operations. Univariate analysis showed that the use of antibiotics between the initial intervention and re-operation was a significant risk factor for ESBL (p = 0.017), but none of these risk factors were associated with the presence of MDR bacteria

Table 3: Rates of ESBL (+) and MDR bacteria according to the presence of risk factors.

| Variables | ESBL (–) (n: 28) | ESBL (+) (n: 51) | p | MDR (–) (n: 56) | MDR (+) (n: 23) | p |
|---|---|---|---|---|---|---|
| Groups | | | 0.847 | | | 1.000 |
| CO-cIAI | 6 (21.4%) | 10 (19.6%) | | 11 (19.6)% | 5 (21.7%) | |
| HCA-IAI | 22 (78.6%) | 41 (80.4%) | | 45 (80.4%) | 18 (78.3%) | |
| Before initial intervention | | | 0.196 | | | 0.738 |
| Hospitalization (–) | 26 (92.9%) | 41 (80.4%) | | 48 (85.7%) | 19 (82.6%) | |
| Hospitalization (+) | 2 (7.1%) | 10 (19.6%) | | 8 (14.3%) | 4 (17.4%) | |
| Before initial intervention | | | 1.000 | | | 1.000 |
| Use of antibiotics (–) | 27 (96.4%) | 48 (94.1%) | | 53 (94.6%) | 22 (95.7%) | |
| Use of antibiotics(+) | 1 (3.6%) | 3 (5.9%) | | 3 (5.4%) | 1 (4.3%) | |
| Between initial intervention and re-operation | | | 0.017 | | | 0.198 |
| Use of antibiotics (–) | 9 (40.9%) | 6 (14.3%) | | 13 (28.3%) | 2 (11.1%) | |
| Use of antibiotics (+) | 13 (59.1%) | 36 (85.7%) | | 33 (71.7%) | 16 (88.9%) | |

CO-cIAIs:Community onset-complicated intra-abdominal infections, HCA-IAI: Healthcare-associated- intra-abdominal infections, ESBL: Extended-spectrum beta-lactamases, MDR: Multi-drug resistant, spp:species

The overall mortality rate was 22.8% and according to univariate analysis, none of the patient characteristics (age, gender, and comorbidities) were associated with mortality. In addition, the type and timing of the operation and unexpectedly, contamination type were not predictive of death. Among IAI diagnoses, only small intestinal anastomosis leakage was statistically associated with mortality (p = 0.010) and all three patients with this type of infection died (p = 0.010)

Table 4: Demographic and clinical features of cases from the survival and exitus groups

| Variables | Survival (n: 61) | Exitus (n: 18) | p | OR (95% CI) |
|---|---|---|---|---|
| Age (years) | 52.5 ± 17.6 | 60.3 ± 17.4 | 0.103 | 1.026 (0.994–1.059) |
| Gender | | | | |
| Female | 24 (39.3%) | 10 (55.6%) | - | 1.000 |
| Male | 37 (60.7%) | 8 (44.4%) | 0.222 | 0.519 (0.179–1.501) |
| Comorbidities | | | | |
| DM | 8 (13.1%) | 6 (33.3%) | 0.075 | 3.313 (0.968–11.333) |
| COPD | 6 (9.8%) | 5 (27.8%) | 0.113 | 3.526 (0.931–13.356) |
| HT | 13 (21.3%) | 6 (33.3%) | 0.350 | 1.846 (0.581–5.864) |
| CRF | 4 (6.6%) | 0 (0.0%) | 0.569 | - |
| Malignancy | 17 (27.9%) | 6 (33.3%) | 0.654 | 1.294 (0.419–4.000) |
| Immunosuppressive therapy | 3 (4.9%) | 1 (5.6%) | 1.000 | 1.137 (0.111–11.652) |
| Cardiovascular Disease | 4 (6.6%) | 2 (11.15) | 0.615 | 1.781 (0.299–10.623) |
| Groups | | | | |
| CO-cIAIs | 13 (21.3%) | 3 (16.7%) | - | 1.000 |
| HCA-IAIs | 48 (78.7%) | 15 (83.3%) | 1.000 | 1.354 (0.340–5.398) |
| Diagnosis of cIAIs | | | | |
| Intraabdominal abscess | 34 (55.7%) | 6 (33.3%) | 0.095 | 0.397 (0.132–1.196) |
| Colon anastomosis leakage | 6 (9.8%) | 2 (11.1%) | 1.000 | 1.146(0.211–6.237) |
| Gallbladder perforation | 6 (9.8%) | 1 (5.6%) | 1.000 | 0.539 (0.061–4.798) |
| Small intestine perforation | 4 (6.6%) | 2 (11.1%) | 0.615 | 1.781 (0.299–10.623) |
| Colon perforation | 4 (6.6%) | 2 (11.1%) | 0.615 | 1.781 (0.299–10.623) |
| Perforated appendicitis | 4 (6.6%) | 0 (0.0%) | 0.569 | - |
| Small intestine anastomosis leakage | 0 (0.0%) | 3 (16.7%) | 0.010 | - |
| Peptic ulcer perforation | 2 (3.3%) | 1 (5.6%) | 0.545 | 1.735 (0.148–20.318) |
| Gastric anastomosis leakage | 1 (1.6%) | 1 (5.6%) | 0.406 | 3.529 (0.210–59.428) |
| Timing of operation | | | | |
| Elective | 25 (41.0%) | 11 (61.1%) | - | 1.000 |
| Urgent | 36 (59.0%) | 7 (38.9%) | 0.132 | 0.442 (0.151-1.296) |
| Type of surgery | | | | |
| Laparoscopic | 9 (14.8%) | 2 (11.1%) | - | 1.000 |
| Open | 52 (85.2%) | 16 (88.9%) | 1.000 | 1.385 (0.271–7.077) |
| Type of contamination | | | | |
| Dirty | 25 (41.0%) | 5 (27.8%) | - | 1.000 |
| Clean contamination | 15 (24.6%) | 9 (50.0%) | 0.089 | 3.000 (0.845–10.649) |
| Contamination | 21 (34.4%) | 4 (22.2%) | 0.947 | 0.952 (0.226–4.008) |

CO-cIAIs:Community onset-complicated intra-abdominal infections, HCA-IAI: Healthcare-associated- intra-abdominal infections, DM: Diabetes mellitus, COPD: Chronic obstructive pulmonary disease, CRF: Chronic renal failure, HT: Hypertension, OR:Odds Ratio, CI:Confidence Interval

A statistically significant difference between the survival and the exitus groups in terms of MDR positivity was observed (p = 0.026). Mortality in the MDR (+) group was 3,357 times higher than (95% confidence interval: 1.118–10.084) that of the MDR (–) group. The mortality rate statistically significantly increased 3.833 times and 7.127 times by growing enterococcus and Acinetobacter in culture (95% confidence interval: 1.280–11.484) (p = 0.013) (95% confidence interval: 1.909–26.605) statistically (p = 0.004)

Table 5: Distribution of cases in terms of agents according to survival and exitus groups.

| Variables | Survival (n: 61) | Exitus (n: 18) | p | OR (95% CI) |
|---|---|---|---|---|
| Polymicrobial | 30 (49.2%) | 12 (66.7%) | 0.191 | 2.067 (0.687–6.215) |
| ESBL | 37 (60.7%) | 14 (77.8%) | 0.182 | 2.270 (0,667–7.722) |
| MDR | 14 (23.0%) | 9 (50.0%) | 0.026 | 3.357 (1.118–10.084) |
| *E.coli* | 42 (68.9%) | 8 (44.4%) | 0.059 | 0.362 (0,123–1.062) |
| *Klebsiella* spp. | 14 (23.0%) | 3 (16.7%) | 0.749 | 0.671 (0.170–2.658) |
| *Enterococcus* spp. | 15 (24.6%) | 10 (55.6%) | 0.013 | 3.833 (1.280–11.484) |
| *Pseudomonas* spp. | 6 (9.8%) | 2 (11.1%) | 1.000 | 1.146 (0.211–6.237) |
| *Acinetobacter* spp. | 5 (8.2%) | 7 (38.9%) | 0.004 | 7.127 (1.909–26.605) |
| Other Enterobacterales | 5 (8.2%) | 4 (22.2%) | 0.198 | 3.200 (0.759–13.497) |

ESBL: Extended-spectrum beta-lactamases, MDR: multi-drug resistant, spp:species, OR:Odds Ratio, CI: Confidence Interval

Multiple logistic regression analysis analyzed all possible risk factors that are potential determinants for distinguishing between the survival and exitus groups. Especially the presence of Acinetobacter spp. and Enterococcus spp. infections and COPD were related to higher mortality rates. Interestingly, dirty operations negative correlated with mortality

Table 6: Examination of the effects of all possible risk factors which may be determinants for distinguishing between the survival and exitus groups; risk factors were analyzed by multiple logistic regression with multivariate stepwise logistic regression analysis.

| Variables | Odds ratio | 95% confidence interval | | p |
|---|---|---|---|---|
| | | *Lower limit* | *Upper limit* | |
| Initial Model | | | | |
| Age | 1.027 | 0.968 | 1.089 | 0.378 |
| Male | 0.641 | 0,.093 | 4.425 | 0.652 |
| DM | 1.169 | 0.147 | 9.290 | 0.882 |
| COPD | 6.963 | 0.533 | 90.929 | 0.139 |
| Urgent | 5.052 | 0.141 | 180.625 | 0.375 |
| Contamination | 0.090 | 0.005 | 1.527 | 0.095 |
| Dirty | 0.009 | 0.000 | 1.119 | 0.056 |
| Polymicrobial | 0.179 | 0.018 | 1.759 | 0.140 |
| ESBL | 5.269 | 0.431 | 64.435 | 0.193 |
| MDR | 0.230 | 0.017 | 3.044 | 0.265 |
| *E.coli* | 0.213 | 0.031 | 1.463 | 0.116 |
| *Enterococcus* spp. | 22.141 | 2.278 | 215.217 | 0.008 |
| *Acinetobacter* spp. | 83.517 | 3.261 | 2138.697 | 0.007 |
| Other microorganisms | 8.309 | 0.828 | 83.331 | 0.072 |
| Intraabdominal abscess | 0.399 | 0.068 | 2.339 | 0.309 |
| Final model | | | | |
| COPD | 5.770 | 1.060 | 31.416 | 0.043 |
| Contamination | 0.229 | 0.042 | 1.246 | 0.088 |
| Dirty | 0.127 | 0.022 | 0.723 | 0.020 |
| *Enterococcus* spp. | 8.122 | 1.869 | 35.286 | 0.005 |
| *Acinetobacter* spp. | 12.638 | 2.461 | 64.896 | 0.002 |

DM: Diabetes mellitus, COPD: Chronic obstructive pulmonary disease, ESBL: Extended-spectrum beta-lactamases, MDR: multi-drug resistant, spp:species

## DISCUSSION

This single-center, retrospective study demonstrated the relation between mortality and the causative agents, resistance rates and clinical and microbiological characteristics community-onset and healthcare-associated cIAIs. Although routinely obtaining peritoneal fluid culture is not recommended in lower-risk patients with community acquired cIAIs, knowledge of local microbiological and resistance patterns is essential for selecting the appropriate antibiotic therapy.[5]

As previous national and international studies also reported high resistance rates in gram-negative isolates obtained from extra-abdominal regions, it is not surprising that we also observed higher resistance rates in community-onset and nosocomial isolates in this study.[6-8] However, the rates compared are not for cIAIs, and the number of national studies on this topic is still limited. Nevertheless there is not enough data from our country regarding the epidemiology of microorganisms that cause community and hospital-acquired intra-abdominal infections, ESBL rate in gram-negative bacteria in community-acquired infections was found to be 12.3% in one study.[9] Since these data include only community-acquired infections, resistance rates are much lower compared to ours. Also, our high resistance rates in community-onset infections were associated with the lack of reliable data on 12-month healthcare utilization. In a multinational study involving centers from around the world, both community and hospital-acquired intraabdominal infections were evaluated, and the ESBL rate among Gram-negative bacteria was found to be 16.4%.[10] Given that antimicrobial resistance in our country is known to be high according to the antimicrobial surveillance data published by the World Health Organization, this rate is an expected finding.[11] Acinetobacter baumannii, a causative agent of other hospital-acquired infections (pneumonia, sepsis) at our institution, was isolated at a higher rate than previous reports on HCA-IAIs.

Previous exposure to antibiotics increases ESBL positivity and is associated with the development of resistant bacteria. This fact was supported by our finding that using antibiotics between two operations represented a risk factor for isolating ESBL-positive gram-negative bacteria.[12-13] While the relationship between other risk factors and the development of resistant bacteria was previously demon-

strated in the literature, these risk factors and the development of resistant bacteria were not significantly associated with ESBL positivity and MDR development in this study. This may be due to the limited data (preoperative hospitalization occurred for only 15.2% of patients and preoperative antibiotherapy in 5.1%).

Age, infection severity, surgical intervention type, microbial factors, the timing and adequacy of antimicrobial therapy, comorbidities, and Acute Physiology and Chronic Health Evaluation-II (APACHE-II) and Sequential organ failure assessment (SOFA) scores on admission have been examined as mortality predictors in the literature.[14] In recent studies, the failure of initial antibiotic therapy and the isolation of resistant pathogens are risk factors for mortality.[15,16] Surgical guidelines emphasize that empiric therapy should be directed according to local microbiological data and resistance patterns.[2,3] Mortality was associated with MDR bacteria only during univariate analysis, while it was associated with isolation of Acinetobacter in both univariate and multivariate analyses in the present study. As most of the cases in the study were postoperative infections, the isolation of MDR pathogens and the correlation between the rates of resistant bacteria and mortality were as expected. There was similarity between the mortality rate in this study (22%) and the rates previously reported in the literature for postoperative infections.[14,17]
While medical guidelines recommend using empirical anti-enterococcal treatment in high-risk patients, the isolation of Enterococci from cIAIs was previously associated with treatment failure and mortality in several studies in the literature.[18,19] In our study, where Enterococci were the second most isolated species, univariate and multivariate analyses supported the previous findings. Riche et al.s' findings show that the isolation of Enterococci species from peritoneal fluids represents a poor prognostic factor, demonstrating the need for additional prospective studies evaluating the effective systemic antibiotic therapy for these microorganisms.[20]
Similar to our findings, Riche previously reported similar mortality rates between community-acquired and nosocomial infections and identified septic shock as the main determinant of mortality. Likewise, Claridge et al. demonstrated that whether an infection was community-acquired or nosocomial had less impact on the patient mortality rate than intrinsic patient characteristics.[21] In our study, only a history of COPD among the comorbidities was associated with increased mortality, based on the multivariate analyses. However, this finding should be further evaluated in future studies.
While a relationship was not found between the type of contamination and mortality in Van Ruler's study, we believe that the lower rate of mortality observed for dirty operations in this study could be explained by the fact that surgeons generally ask for consultation from emergency infectious diseases departments in the presence of dirty infections. Large-spectrum antimicrobial therapy is initiated earlier in those patients.[17]
Our study has some limitations. The patients' status at presentation was described as a mortality predictor, and it included the Charlson and APACHE indexes and septic shock, but we could not investigate these prognostic parameters.[20,22] Nevertheless, our data can contribute to the currently limited regional resistance rates and show the importance of local microbiological patterns of IAIs. In addition, the risk factors affecting mortality support previous studies in the literature.

## CONCLUSION

Due to the increase in the prevalence of ESBL-positive and MDR bacteria, the epidemiological data in populations and in each hospital / (locally/regionally) is essential for accurate selection of initial empirical antibiotherapy. The risk factors for developing resistant bacteria should be carefully observed and assessed in community-acquired infections. MDR bacteria and Acinetobacter species are a serious threat to cIAI cases. At the same time, Enterococcus species also appear as a more significant concern than before.

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