ASIAN JOURNAL OF PHARMACEUTICAL AND CLINICAL RESEARCH

INNOVARE ACADEMIC SCIENCES
Knowledge to Innovation

Vol 17, Issue 11, 2024

Online - 2455-3891
Print - 0974-2441

Research Article

# TO STUDY THE CLINICO-MICROBIOLOGICAL PROFILE OF AN INTRA-ABDOMINAL INFECTIONS IN THE SURGICAL INTENSIVE CARE UNIT

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*Received: 17 July 2024, Revised and Accepted: 03 September 2024*

## ABSTRACT

**Objective:** Intra-abdominal infections (IAIs) pose a severe challenge in surgical intensive care units (ICUs). These infections, which can develop from conditions such as peritonitis, appendicitis, and intra-abdominal abscesses, often worsen into severe complications such as sepsis and multi- organ failure. Early and accurate diagnosis, along with rapid and effective treatment, is crucial for improving the survival and recovery of patients in the surgical ICU who are affected by these life-threatening infections. This study focuses on the clinical and microbiological profile of IAIs in the surgical ICU, emphasizing the importance of understanding the microbial landscape.

**Methods:** This prospective study was carried out in the Department of Microbiology over the course of 1 year. Patients with suspected IAIs admitted to the surgical ICU were included in the study. The samples were received and processed as per standard protocols. Identification and antimicrobial susceptibility testing were done by the Vitek-2 system, and isolates were characterized as multi-/extensively/pan-drug resistant.

**Results:** Out of 1010 patients admitted to the surgical ICU, infections were present in 81 patients (53 males and 28 females), resulting in an infection rate of 8%. The most common comorbidity was diabetes mellitus (28.3%), and the most common risk factors were sepsis (19.7%), alcohol intake (18.5%), and immobilization (16%). A total of 87 isolates were obtained. The most common isolate was *Escherichia coli* (47.1%), followed by *Klebsiella pneumoniae* (26.4%). *E. coli* showed maximum sensitivity for amikacin (76.7%), followed by tigecycline (74.4%). 81.6% of isolates were multidrug-resistant, and 62.7% were extensively drug-resistant.

**Conclusion:** Knowledge of antimicrobial resistance patterns provides guidance for the treatment, thus improving outcomes.

**Keywords:** Intra-abdominal infections, Surgical intensive care unit, Antimicrobial susceptibility testing.

 DOI: http://dx.doi.org/10.22159/ajpcr.2024v17i11.52085. Journal homepage: https://innovareacademics.in/journals/index.php/ajpcr

## INTRODUCTION

Severe intra-abdominal infections (IAIs) are a frequent and significant issue in intensive care units (ICUs) [1]. These encompass a diverse range of conditions, from relatively mild cases such as acute appendicitis to more severe issues such as peritonitis and intestinal perforation, which carry a high risk of significant morbidity and mortality [2,3]. Each year, over 300,000 individuals are diagnosed with appendicitis, leading to more than 1 million hospital days. Factors such as surgical interventions, trauma, aging, chronic conditions such as cancer and diabetes mellitus, along with lifestyle behaviors such as smoking and alcohol abuse are strongly linked to the risk of bacterial invasion into the abdominal cavity [4]. The primary pathogens responsible for IAIs include *Enterobacteriaceae*, with *Escherichia coli* being the most prevalent, and anaerobes, particularly *Bacteroides fragilis*. The growing issue of resistant microorganisms is increasingly complicating the management of IAI cases [5]. Appropriate empirical therapy is crucial in determining the outcomes of patients diagnosed with IAIs. Inadequate or delayed antibiotic treatment is associated with higher rates of treatment failure and an increased risk of mortality [6]. Therefore, it is crucial to prevent the emergence and spread of resistant organisms and to manage them effectively to control infections. In addition, ongoing antimicrobial susceptibility surveillance is essential to address the increasing rate of resistance [7]. This study examines the incidence, clinical characteristics, and microbiological profile of IAIs in patients admitted to the surgical ICU. The findings will offer essential insights for creating local guidelines to improve the prevention and management of IAIs in ICU settings.

## METHODS

This prospective study was carried out in the Department of Microbiology over 1 year period, following approval from the institutional ethical committee. The study included patients suspected of having IAIs. Various body fluids, including ascitic fluid, bile, drain fluid, gallbladder fluid, Percutaneous nephrostomy (PCN) fluid, and peritoneal fluid, were collected and processed in the microbiology laboratory according to standard protocols [8]. The samples were inoculated into the BD BACTEC Fx (Becton Dickinson, USA) or BacT/Alert 3D (bioMérieux, France) automated culture systems and monitored for up to 7 days. Identification and antibiotic sensitivity testing of the isolates were performed using the Vitek2 system. The isolates were subsequently classified based on their resistance profiles into multidrug resistant (MDR), extensively drug resistant (XDR), or pandrug resistant (PDR) [9,10]. Data were analyzed using Statistical Packages for the Social Sciences version 21.0 software, with statistical significance defined as $p<0.05$.

## RESULTS

Out of 1010 patients admitted to the surgical ICU, 81 had infections (53 males and 28 females), with an infection rate of 8%. The mean age of patients was 50.7. Comorbid illness was observed in 67.9% of the patients, with diabetes mellitus being the most common, affecting 28.3%. The most common risk factors were sepsis (19.7%), alcohol intake (18.5%), and immobilization (16%). The most common clinical presentation was intestinal obstruction/gastrointestinal (GI) bleed followed by GI perforation. The mean ICU stay was 8.3 days, and the mean APACHE II score was 14.8 (Table 1).

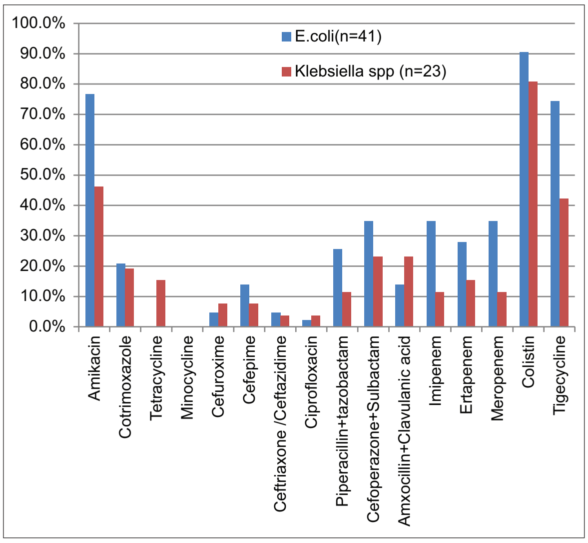


**Fig. 1: Antibiotic sensitivity profile of predominant Gram-negative body fluid isolates**

**Table 1: Characteristics of patients with IAIs (n=81)**

| Characteristic | Patients with IAIs (n=81) |
|---|---|
| Mean age (years) | 50.7 |
| Male: Female | 1.9:1 |
| Mean APACHE 2 score | 14.8 |
| Mean ICU stay (days) | 8.3 |
| Risk factors (%) | |
| Sepsis | 16 (19.7) |
| Alcohol intake | 15 (18.5) |
| Immobilization | 13 (16) |
| Elderly(>70 years) | 9 (11.1) |
| Immunocompromised | 5 (6.2) |
| Diagnosis (%) | |
| Intestinal obstruction/GI bleeding | 21 (25.9) |
| GI perforation | 19 (23.5) |
| Appendicitis/pancreatitis | 17 (20.9) |
| Cholecystitis/cholelithiasis | 10 (12.3) |
| Carcinoma | 5 (6.2) |
| RSA/polytrauma | 4 (4.9) |
| Hernia | 2 (2.5) |
| Others | 3(3.7) |
| Outcome (%) | |
| Survived | 55 (67.9) |
| Expired | 26 (32.1) |

IAIs: Intra-abdominal infections, ICU: Intensive care unit, GI: Gastrointestinal. RSA: Road side accident

A total of 87 isolates were obtained, with monomicrobial growth present in 75 patients and polymicrobial growth in six patients. Gram-negative isolates were predominant 75 (86.2%) than Gram-positive 12 (13.8%). The most common isolate was *E. coli* (47.1%) followed by *Klebsiella pneumoniae* (26.4%) (Table 2).

*E. coli* and *K. pneumoniae* showed the highest sensitivity to amikacin (76.7% and 46.2%, respectively), followed by tigecycline (74.4% and 42.3%, respectively) (Fig. 1).

Among Gram-positive isolates, *Enterococcus* spp. showed the maximum sensitivity to teicoplanin (71.4%), followed by levofloxacin and erythromycin (44.4% each). Out of seven isolates of *Enterococcus* spp, 28.6% were vancomycin-resistant *Enterococcus*. All coagulase-negative staphylococci were sensitive to teicoplanin, vancomycin, and linezolid (100%). Out of 87 isolates, 71 (81.6%) were MDR, 54 (62.7%) were XDR, and no isolate was PDR. Seven patients (8.6%) had concurrent bacteremia. 67.9% of patients survived, and 32.1% of patients expired.

## DISCUSSION

In a period of 1 year, 1010 patients were admitted to the surgical ICU, and IAIs were present in 81 patients with an infection rate of 8%. The majority of patients were males (65.4%) as compared to females (34.6%), similar to the study done in Ethiopia (Males=67% and Females=33%) [7]. The mean age of patients was 50.7, consistent with the study by Chaithanya *et al.* [11]. Out of 81 patients, 28.3% were diabetic, similar to the study by Silva-Nunes and Cardoso which also identified diabetes as the predominant comorbidity (29%) [6]. 25.9% of the patients with infections were admitted due to intestinal obstruction or GI bleeding (25.9%), whereas the study by Blot *et al.* identified peritonitis (68.4%) as the most common clinical presentation [1].

Gram-negative organisms were predominant (86.2%) as compared to Gram-positive organisms (13.8%). Our data were similar to the study done by Admas *et al.*, in which Gram-negative isolates accounted for 64.3% of IAIs [4]. This was in contrast with the studies done by Tsegay *et al.* [7] and Bourbeau *et al.* [12], which showed that most IAIs were caused by Gram-positive isolates (52.3% and 60.8%, respectively).

The most common isolate identified was *E. coli* (47.1%), followed by *K. pneumoniae* (26.4%). These findings were consistent with the studies by Ouyang *et al.* [13] and Shree *et al.* [14], who reported *E. coli* as the predominant isolate in patients with IAIs, with frequencies of 47.6% and 43.5%, respectively. E. coli exhibited the highest sensitivity to amikacin (76.7%), followed by tigecycline (74.4%). Similar findings were observed in various studies conducted by Chaithanya *et al.*, Montravers *et al.*, and Lugito *et al.* [11,15,16].

**Table 2: Sample-wise distribution of isolates**

| Organisms | Ascitic fluid | Bile | Drain fluid | PCN | Peritoneal fluid | Total |
|---|---|---|---|---|---|---|
| Gram-negative isolates | | | | | | |
| *Escherichia coli* | 2 | 3 | 7 | 1 | 28 | 41 |
| *Klebsiella pneumoniae* | 2 | 1 | 14 | - | 6 | 23 |
| *Pseudomonas aeruginosa* | - | 1 | 2 | - | - | 3 |
| *Enterobacter* spp. | - | - | 1 | 1 | 1 | 3 |
| *Sphingomonas paucimobilis* | - | - | 1 | - | 1 | 2 |
| *Acinetobacter baumannii* | 1 | - | - | - | - | 1 |
| *Proteus mirabilis* | - | - | 1 | - | - | 1 |
| *Serratia liquefaciens* | - | - | 1 | - | - | 1 |
| *Gram-positive isolates* | | | | | | |
| *Enterococcus faecalis* | 1 | 1 | 1 | - | - | 3 |
| *Enterococcus faecium* | - | - | 2 | - | - | 2 |
| *Enterococcus gallinarum* | - | 1 | 1 | - | - | 2 |
| *Staphylococcus haemolyticus* | - | - | 2 | - | 1 | 3 |
| *Staphylococcus saprophyticus* | - | - | 1 | - | - | 1 |
| *Streptococcus agalactiae* | - | - | - | - | 1 | 1 |
| Total | 6 | 7 | 34 | 2 | 38 | 87 |

In this study, high rates of MDR (81.6%) were reported, which is comparable to the findings by Admas *et al.* (78.6%) and Ebrahim *et al.* (75%) [4,17].

In our study, seven patients (8.6%) had concurrent bacteremia. This finding is similar to the results of Montravers *et al.* (6%) [15] but was considerably lower than the data observed by Silva-Nunes and Cardoso (57%) and Krobot *et al*. (43%) [6,18]. Microbiological cultures, including blood cultures, are crucial for determining appropriate antibiotic therapy in IAIs and should be collected from every patient with IAIs.

The hospital mortality observed in this study was higher than that described by Sartelli *et al*. (32.1% vs. 22%) [19].

## CONCLUSION

Appropriate and accurate intervention is crucial in minimizing the severe consequences of these infections. Early medical care significantly improves patient outcomes by preventing complications, which highlights the essential role of prompt treatment in managing affected patients effectively.

## ACKNOWLEDGMENT

Technical support of Mr. Deep Chand and Mr. Ghanshyam Moria.

## AUTHOR'S CONTRIBUTIONS

Amarpreet Kaur- Concepts, design, the definition of intellectual content, literature search, data acquisition, data analysis, statistical analysis, manuscript preparation, manuscript editing, and review. Veenu Gupta and PL Gautam- Concepts, design, the definition of intellectual content, data analysis, manuscript editing, and review.

## CONFLICT OF INTEREST

None.

## AUTHOR'S FUNDING

NA.

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