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Research Article

Study on Microbiology Culture of Appendicular Stump and Surgical Site Infection Following Appendicectomy in a Tertiary Care Hospital in North Karnataka, India

Dr. Udaykumar K.V.[1], Dr. Sarath Kumar[2], Dr. Hassan Seham[3]

[1]Associate Professor, Department of General Surgery, Karnataka Medical College and Research Institute (KMCRI), Hubli, Karnataka, India.
[2]Postgraduate Student, Department of General Surgery, Karnataka Medical College and Research Institute (KMCRI), Hubli, Karnataka, India.
[3]Postgraduate Student, Department of General Surgery, Karnataka Medical College and Research Institute (KMCRI), Hubli, Karnataka, India.

*Corresponding Author
Dr. Udaykumar K.V., Associate Professor, Department of General Surgery, Karnataka Medical College and Research Institute (KMCRI), Hubli, Karnataka, India.A

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Abstract: ***Introduction:*** Appendicitis is a common surgical emergency requiring prompt appendicectomy. Despite advances in surgical care, SSIs (Surgical Site Infections) remain a significant postoperative complication. The microbiological profile of the appendicular stump plays a crucial role in the development of SSIs. Understanding the correlation between stump culture and wound infections can help guide targeted antibiotic therapy and improve patient outcomes.**Methods:** This prospective observational study was conducted at Karnataka Institute of Medical Sciences (KIMS), Hubballi, over 18 months. A total of 96 patients undergoing open appendicectomy were included. Intraoperative swabs from the appendicular stump were collected for microbiological culture, and postoperative wound swabs were analyzed on day 3. Demographic data, intraoperative findings, microbial profiles, and antibiotic sensitivity patterns were recorded and analyzed using descriptive statistics and correlation tests.**Results:**The majority of patients were young adults aged 20–30 years, with male predominance (68%). The most common intraoperative finding was an inflamed appendix (67 cases). Escherichia coli was the predominant organism isolated from appendicular stump cultures (68%) and wound cultures (39.4%). Other organisms included Klebsiella, Pseudomonas aeruginosa, Streptococcus, and Staphylococcus aureus. A strong correlation (84.5%) was observed between stump and wound cultures. Approximately 39.1% of patients developed superficial SSIs. Antibiotic sensitivity testing showed high effectiveness of piperacillin/tazobactam, cefotaxime, and amikacin, while resistance was noted for gentamycin and amoxicillin/clavulanic acid. **Conclusion:**The study demonstrates that E. coli is the predominant pathogen in both appendicular stump and surgical site infections. A strong correlation between stump and wound cultures highlights the importance of intraoperative contamination in SSI development. Routine microbiological culture and antibiotic sensitivity testing are essential for guiding targeted therapy, improving outcomes, and addressing emerging antimicrobial resistance.

Keywords: Appendicitis, Appendicectomy, Appendicular Stump Culture, Surgical Site Infection, Escherichia Coli, Antibiotic Sensitivity, Microbiology.

INTRODUCTION

Acute appendicitis is one of the most common causes of acute abdomen worldwide and represents a frequent indication for emergency abdominal surgery.[1] It affects individuals across all age groups but is most prevalent among young adults. If not diagnosed and managed promptly, appendicitis can progress to serious complications such as perforation, generalized peritonitis, and intra-abdominal abscess formation, which significantly increase morbidity and healthcare burden.[2] Appendicectomy, performed either by open or laparoscopic approach, remains the gold standard treatment; however, postoperative complications-particularly SSIs (Surgical Site Infections)-continue to be a major concern in clinical practice.[3]

The occurrence of SSIs following appendicectomy is strongly influenced by the microbial flora of the appendix and appendicular stump. The normal appendix contains a complex and diverse microbiota, predominantly anaerobic organisms such as Bacteroides fragilis, along with facultative anaerobes including Escherichia coli and Enterococcus species.[4] During the inflammatory process of appendicitis, luminal obstruction and mucosal damage promote bacterial overgrowth and facilitate translocation of microorganisms into the peritoneal cavity, leading to polymicrobial infections.[5]

Multiple studies have demonstrated that Escherichia coli is the most frequently isolated pathogen in both appendicular infections and postoperative wound infections. Other commonly implicated organisms

include Klebsiella, Pseudomonas aeruginosa, and Streptococcus species.[6] The similarity between microorganisms isolated from the appendicular stump and those found in surgical wounds suggests that intraoperative contamination plays a crucial role in the development of SSIs.[7]

Microbiological culture of the appendicular stump is therefore a valuable diagnostic and prognostic tool. It helps identify the causative organisms and determine their antibiotic susceptibility patterns, which is particularly important in the current era of increasing antimicrobial resistance.[8] Culture-guided therapy not only improves patient outcomes but also supports rational antibiotic use.

AIMS AND OBJECTIVES

The aim of this study was to evaluate the microbiological culture of the appendicular stump and its association with SSIs following appendicectomy. The primary objective was to analyze the microbiological profile of the appendicular stump and determine its correlation with the occurrence of SSIs following open appendicectomy. The secondary objective was to identify the predominant microbial pathogens involved and to assess their antibiotic sensitivity patterns, thereby aiding in the selection of appropriate antimicrobial therapy and improving postoperative patient outcomes.

MATERIALS AND METHODS

Study Design

This study was designed as a prospective observational study conducted at the Karnataka Institute of Medical Sciences (KIMS), Hubballi, a tertiary care center in North Karnataka, India. The study was carried out over a period of 18 months from June 2023 to November 2024. This design enabled the collection of real-time clinical and microbiological data to analyze the appendicular stump culture and its correlation with surgical site infections following appendicectomy, without any intervention beyond standard patient care.

Inclusion and Exclusion Criteria

Patients presenting with a history of abdominal pain diagnosed as acute appendicitis confirmed by ultrasonography and planned for surgical management were included in the study, along with those undergoing elective and emergency open appendicectomy. Patients who underwent laparoscopic appendicectomy, those presenting with generalized peritonitis, and cases of incidental appendicectomy were excluded from the study.

Sample Size Calculation

The study was conducted with a minimum sample size of 96 patients. This sample size was determined based on previous studies and statistical considerations to ensure reliable results in microbiological analysis and postoperative infection rates.

Data Collection Procedure

Data collection was carried out systematically using a structured case record form for all enrolled patients. Patients were clinically evaluated on admission with detailed history, physical examination, and relevant laboratory investigations, along with ultrasonography to confirm acute appendicitis. Intraoperatively, a swab sample was obtained from the appendicular stump for microbiological culture. Relevant parameters including demographic details, preoperative findings, intraoperative observations, and postoperative outcomes were recorded. Patients were subsequently monitored for the development of surgical site infections, and wound swabs were analyzed when indicated. Microbiological culture reports and antibiotic response were documented, and all data were entered into an electronic database for further statistical analysis.

Statistical Analysis

Data analysis was performed using appropriate descriptive and inferential statistical methods. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. The association between appendicular stump microbiological culture results and the occurrence of SSI was evaluated using the chi-square test and logistic regression analysis. A p-value of less than 0.05 was considered statistically significant.

RESULTS

1. Age Group (in years)	2. Number of Cases
3. 20–30	4. 57
5. 30–40	6. 26
7. 40–50	8. 8
9. 50–60	10. 4
11. 60–70	12. 0
13. 70–80	14. 1

15. ***Table 1: Age Distribution of Patients***

Table 1 shows that the majority of patients belonged to the 20–30 year age group, indicating that appendicitis predominantly affects young adults. There is a gradual decline in cases with increasing age.

16. Gender	**17. Percentage (%)**
18. Male	19. 68%
20. Female	21. 32%
22. *Table 2: Gender Distribution*	

Table 2 illustrates a clear male predominance in appendicitis cases, with males accounting for more than two-thirds of the study population.

23. Finding	**24. Number of Cases**
25. Inflamed Appendix	26. 67
27. Perforated Appendix	28. 14
29. Appendicular Abscess	30. 8
31. Appendicular Mass	32. 8
33. *Table 3: Intraoperative Findings*	

Table 3 shows that the majority of patients had an inflamed appendix, while complicated cases such as perforation, abscess, and mass were less frequent but clinically significant.

34. Organism	**35. Percentage (%)**	**36. Cases**
37. Escherichia coli	38. 68%	39. 66
40. Klebsiella species	41. 4.1%	42. 4
43. Pseudomonas aeruginosa	44. 3%	45. 3
46. Streptococcus species	47. 10.3%	48. 10
49. Enterococcus species	50. 3%	51. 3
52. Staphylococcus aureus	53. 3%	54. 3
55. Mixed Growth	56. ~8%	57. 8
58. *Table 4: Appendicular Stump Culture – Microbial Profile*		

Table 4 demonstrates that *E. coli* is the predominant organism in appendicular stump cultures, followed by Streptococcus species. The presence of mixed growth indicates polymicrobial infections.

59. Organism	**60. Percentage (%)**	**61. Cases**
62. Escherichia coli	63. 39.4%	64. 15
65. Klebsiella species	66. 15.7%	67. 6
68. Pseudomonas aeruginosa	69. 10.5%	70. 4
71. Streptococcus species	72. 13.1%	73. 5
74. Enterococcus species	75. 5.25%	76. 2
77. Staphylococcus aureus	78. 7%	79. 3
80. Mixed Growth	81. ~7%	82. 3
83. *Table 5: Wound Culture – Microbial Profile*		

Table 5 shows that *E. coli* remains the most common pathogen in wound infections as well, followed by Klebsiella and Streptococcus, indicating similar microbial patterns between stump and wound infections.

84. Correlation Type	**85. Percentage (%)**
86. Same organism	87. 84.5%
88. No growth in wound	89. 10.3%
90. Different organism	91. 5%
92. *Table 6: Correlation between Stump Culture and Wound Culture*	

Table 6 illustrates a strong correlation between appendicular stump and wound cultures, suggesting that intraoperative contamination is a major contributor to surgical site infections.

93. Antibiotic	**94. Sensitivity Pattern**
95. Piperacillin/Tazobactam	96. Highly sensitive (≈100%)
97. Cefotaxime	98. Highly sensitive (≈100%)
99. Amikacin	100. Highly sensitive (≈100%)
101. Imipenem	102. Highly sensitive (≈100%)
103. Amoxicillin/Clavulanic Acid	104. Low sensitivity
105. Gentamycin	106. Low sensitivity

107.*Table 7: Antibiotic Sensitivity Pattern (Common Organisms)*

Table 7 shows that piperacillin/tazobactam, cefotaxime, amikacin, and imipenem are the most effective antibiotics against the isolated organisms, whereas gentamycin and amoxicillin/clavulanic acid show reduced effectiveness, indicating emerging resistance.

DISCUSSION

The present study demonstrated that appendicitis predominantly affects younger individuals, with the majority of patients belonging to the 20–30 years age group (58.8%), followed by the 30–40 years group (26.8%). This finding is consistent with the well-established epidemiological pattern described by Addiss et al.[2] who reported peak incidence in the second and third decades of life. Similarly, Rajesh Kumar and Renu Chauhan[9] observed that appendicitis is most common among young males, while the Global Burden of Disease Study[10] confirmed that the highest disease burden is concentrated in individuals aged 10–30 years. The decline in incidence with advancing age in our study may be attributed to lymphoid tissue atrophy.

A clear male predominance (68%) was observed, which aligns with findings by Pandey et al.[11] who reported a male-to-female ratio of 1.81:1, and epidemiological data from Liv Hospital,[12] suggesting a higher incidence in males possibly due to hormonal and physiological differences.

Intraoperatively, the majority of cases (69.1%) presented with an inflamed appendix, while complicated appendicitis (perforation, abscess, and mass) accounted for 30.8%. This is comparable to the findings of Firdos et al.[13] who reported 67.5% uncomplicated cases. Importantly, complicated appendicitis is associated with a significantly higher risk of SSI, emphasizing the clinical relevance of intraoperative findings.

Microbiological analysis revealed Escherichia coli as the predominant organism in appendicular stump cultures (68%), which is consistent with studies by Jeon HG et al.[14] Chen CY et al.[6] Song DW et al.[15] and Lahiri S[16] all of whom identified E. coli as the most common pathogen. This predominance reflects its role as a normal gut commensal with high pathogenic potential in intra-abdominal infections. Other Gram-negative organisms such as Klebsiella (4.1%) and Pseudomonas aeruginosa (3%) were also identified, consistent with findings by Son JT SH et al.[17] and Kitahara H et al.[18] Although less frequent, these organisms are clinically important due to their antibiotic resistance and association with severe infections.

Among Gram-positive organisms, Streptococcus species (10.3%) were the most common, followed by Enterococcus and Staphylococcus aureus (3% each). These findings are comparable to those reported by Jeon HG et al.[14] Chen CY et al.[6] and Son JT SH et al.[17] The presence of Staphylococcus aureus, though less frequent, remains clinically significant due to its association with surgical site infections, as highlighted by Abramov et al.[19]

The SSI rate in this study was 39.1%, which is higher than some reports but consistent with studies focusing exclusively on open appendicectomy. Jayalal DJ et al.,[20] reported lower SSI rates due to the inclusion of laparoscopic cases, while Pandey et al.,[12] and Firdos et al.,[13] confirmed higher infection rates in open procedures. Wound culture analysis again showed E. coli as the predominant organism (39.4%), followed by Klebsiella, Pseudomonas, and Streptococcus. The increased proportion of Klebsiella and Pseudomonas in wound cultures suggests their role in postoperative infections, as also noted by Song DW et al.[15] and Abramov et al.[19]

A strong correlation (84.5%) between appendicular stump and wound cultures was observed, indicating that intraoperative contamination is the primary mechanism for SSI. Similar findings were reported by Song DW et al.[15] emphasizing the importance of minimizing contamination during surgery.

Antibiotic sensitivity patterns revealed that piperacillin/tazobactam, cefotaxime, amikacin, and imipenem were highly effective against most organisms, consistent with studies by Jeon HG et al.,[14] Ju HU et al.,[21] and Wang et al.[22] However, reduced sensitivity to gentamycin (44%) and Amoxicillin/Clavulanic Acid (25%) highlights emerging resistance trends, necessitating culture-guided therapy and antibiotic stewardship.

This study reinforces the importance of microbiological evaluation of the appendicular stump, correlation with SSI, and the need for targeted antibiotic therapy to improve clinical outcomes.

CONCLUSION

In conclusion, this study underscores the predominant role of Escherichia coli (E. coli) as the leading pathogen in both appendicular stump and surgical wound infections, highlighting its ability to migrate and complicate postoperative outcomes in appendicitis cases. The presence of other organisms such as Klebsiella, Pseudomonas aeruginosa, and Gram-positive bacteria like Streptococcus and Staphylococcus aureus further reflects the polymicrobial nature of these infections, necessitating a comprehensive and often combination-based therapeutic approach. Importantly, the observed antibiotic sensitivity patterns reveal that agents like piperacillin/tazobactam, cefotaxime, and amikacin remain largely effective, whereas increasing resistance to commonly used antibiotics such as gentamycin and amoxicillin/clavulanic acid raises significant clinical concerns. These findings emphasize the critical need for routine microbial culture and sensitivity testing to guide targeted antibiotic therapy, ultimately improving patient outcomes and addressing in the management of appendicitis.

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