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Original Research

Outcome of intra-operative Purulent Peritoneal Fluid Aspirate Culture Results during Appendicectomy in Patients' Management

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Abstract

Background: Intra-operative purulent peritoneal fluid aspirate for microscopy, culture, and sensitivity during appendicectomy is practiced by some surgeons to help in the post-operative management of patients if the patients get unwell, requiring a change of the prescribed pre-operative antibiotics. This study aimed to evaluate if there are benefits from purulent peritoneal fluid aspirate culture results during appendicectomy.
Methodology: This was a retrospective review of medical records and operation notes of all the patients who had an appendicectomy with purulent peritoneal fluid that was aspirated for microscopy culture and sensitivity in the last 3 years (May 2019 to April 2022).
Results: A total of 73 patients had purulent peritoneal fluid culture results and received perioperative intravenous antibiotics. There were 52 (71%) bacteriological positive culture results from the purulent peritoneal fluid aspirates and 21 (29%) negative peritoneal pus culture results. The most common antibiotics administered were a combination of co-amoxiclav and metronidazole 45 (61.6%). One-quarter of the preoperative antibiotics were changed due to the positive microbiology culture results from the peritoneal pus aspirates. The main reasons for the change in antibiotics were intra-abdominal collections and wound infection in 21 (28.8%) of the patients, and Streptoccocus anginosus was the most common organism isolated. A re-operation and/or ultrasound-guided drainage of intra-abdominal collections were avoided in 13 out of 17 patients due to the change of the pre-operative antibiotics following the results from the purulent peritoneal fluid.
Conclusion: The intra-operative purulent peritoneal fluid culture results during appendicectomy contributed positively towards the post-operative management of patients.

Keywords: Acute appendicitis; Appendicectomy; Antibiotics; Peritoneal pus aspirate culture result; Patients' management

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Introduction

Appendicectomy remains one of the most common emergency abdominal procedures performed worldwide. While the diagnosis of appendicitis primarily relies on clinical assessment and sometimes imaging studies, such as ultrasound or computed tomography scans, the management of this acute abdominal surgical condition is mostly surgical intervention [1].

During appendicectomy, the identification of purulent peritoneal fluid, characterised by the presence of pus within the abdominal cavity, may hold significant importance in guiding the post-operative patients' management [2]. In cases of complicated appendicitis with perforated appendicitis, abscess collection, or four quadrants peritonitis, the identification of microbial pathogens may influence the extent of post-operative care of the patients especially when there are post-operative complications such as intra-abdominal collections, wound infection or wound dehiscence requiring multiple wound management procedures and interventions [3].

In recent years, there has been growing interest in the role of intra-operative purulent peritoneal fluid aspirate culture results during appendicectomy [3]. Peritoneal pus aspirate results during appendicectomy may provide crucial information about the microorganisms that potentially cause wound infection and intra-abdominal collection [4]. This is because specific bacteria from the culture results and their antibiotic susceptibility patterns will provide valuable specific antibiotic treatment and potentially reduce the risk of post-operative wound complications, intra-abdominal collections, reduced the length of hospital admissions, reduce bed pressure in the hospitals and improved the patient overall surgical management outcomes [5].This study aimed to evaluate the benefits of the intra-operative purulent peritoneal fluid aspirate culture results during appendicectomy in the post-operative patients' management.

Materials and Methods

The study was conducted at the Paediatric Surgery Department of Hull University Teaching Hospital, United Kingdom. This was a retrospective study designed to evaluate the benefits of purulent peritoneal fluid aspirate culture results during emergency appendicectomy. The hospital records of all children (aged ≤ 16 years) who had appendicectomy for acute appendicitis with purulent peritoneal fluid culture results in 3 years (May 2019 to April 2022) were collated. The patients with appendicitis without purulent peritoneal fluid for culture were excluded from the study. The authors obtained approval from the Hospital's Research Ethics Committee with reference number 2022.091.

The following data were obtained from the medical records of the Hospital Information Service Department: patient age at operation, an indication of surgery, pre-operative antibiotics and post-operative antibiotics used, method of appendicectomy (laparoscopic or open appendicectomy), operative findings, results of the purulent peritoneal fluid microbiology culture, reason(s) for changing antibiotics if any, wound infection and management if any, and intra-abdominal collections and management if any, antibiotics that were changed due to the results of the intra-operative purulent peritoneal fluid culture. We also collected data on the duration of the hospital stay of the patients that were deemed to have overstayed due to the post-operative complications from the appendicectomy. The specific technical details of the operative procedures were not evaluated in this study.

All the patients' medical records, which met the inclusion criteria, were selected and the data collected. The results of microbial peritoneal cultures, antibiotics used from the patients' drug charts, and clinical outcomes were obtained. Postoperative complications were defined as those occurring within 30 days following surgery. All the patients received a minimum of one dose of antibiotics before surgery. The collated data were entered into the IBM statistical package for social sciences (IBM-SPSS-version26.0).

The categorical variables were expressed in frequency tables, percentages, and charts. The mean age and standard deviation were calculated from the group data.

Results

The patients' characteristics

The study comprised of 73 patients, who fulfilled the inclusion criteria. The patients aged ranged from 3 years to 15 years. The mean age of the patients was 10.6 ± 3.1 years. The majority, 43 (58.9%), of the patients were aged 11–15 years. More than 61% of the patients were male, with a male-to-female ratio of 1.4:1. There were 68 laparoscopic appendicectomies and 4 open appendicectomies. Perforated appendicitis was seen in 65 (89%) patients and gangrenous appendicitis in 8 (11%) patients. All 73 patients had at least a dose of pre-operative intravenous antibiotics administered. A total of 68 (93%) patients had pre-operative antibiotics administered in less than 24 hours of admission, while 5 (7%) patients had their pre-operative antibiotics administered within 24-48 hours of admission. The characteristics of patients are demonstrated in Table 1.

Table 1: Patients' characteristics (N=73)

Patients' characteristics	**n (%)**
Age interval (years)	
1-5	8 (11.0)
6-10	22 (30.1)
11-15	43 (58.9)
Gender	
Male	45 (61.6)
Female	28 (38.4)
Appendicitis	
Perforated	65 (89.0)
Gangrenous	8 (11.0)
Duration of pre-operative antibiotics	
<24 hours	68 (93.0)
24-48 hours	5 (7.0)
Appendicectomies	
Laparoscopic	68 (93.0)
Open	5 (7.0)

Pre-operative antibiotics combinations administered

In this study, the patients received a combination of antibiotics, which were all administered intravenously in the preoperative periods. The most common antibiotics combinations administered was Co-amoxiclav and Metronidazole 45 (61.6%). The details of the pre-operative antibiotics administered are as shown in Table 2.

Table 2: Pre-operative antibiotics combinations administered (N=73)

Antibiotics combinations	n (%)
Co-amoxiclav + Metronidazole	45 (61.6)
Co-amoxiclav + Metronidazole + Gentamycin	15 (20.6)
Cefuroxime + Metronidazole	9 (12.4)
Ceftriaxone + Metronidazole	2 (2.7)
Teicoplanin + Metronidazole	2 (2.7)

Peritoneal pus microbiology culture results

There were 52 (71%) positive peritoneal pus culture results and 21 (29%) negative peritoneal pus culture results, as shown in Figure 1.

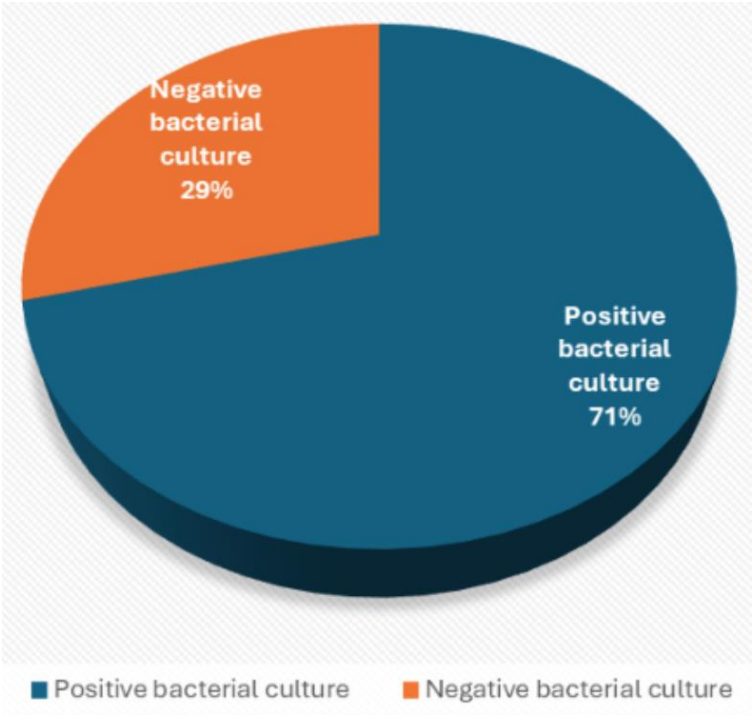

Figure 1. Peritoneal pus bacterial culture results

Positive bacterial culture results and antibiotics sensitivity patterns

Out of the 52 positive results, the most cultured bacteria were Escherisha coli and Streptococcus anginosus, accounting for 23% each, and the least cultured bacteria was Klebsiella pneumoniae (2%). The various sensitivity patterns of the antibiotics for the positive peritoneal pus culture results are highlighted in Table 3.

Table 3: Positive peritoneal pus culture results and antibiotics sensitivity (N = 52)

Bacteria	n (%)	Co-amoxiclav	Metronidazole	Gentamycin	Ciprofloxacin	Teicoplanin	Cefuroxime	Cotrimoxazole	Amoxicillin	Penicillin
Escherichia coli	12 (23)	8	0	10	6	6	5	5	2	5
Streptococcus constellatus	10 (19)	7	2	8	0	3	4	2	2	3
Streptococcus intermedius	2 (4)	2	0	2	1	2	1	0	2	1
Streptococcus pneumoniae	2 (4)	1	0	2	1	0	1	0	0	0
Pseudomonas aeruginosa	5 (10)	3	0	5	1	1	1	2	2	1
Streptococcus anginosus	12 (23)	10	0	10	2	3	3	2	4	3
Klebsiella pneumoniae	1 (2)	1	0	1	0	1	1	0	0	0
Anaerobes	8 (15)	0	8	0	0	1	0	0	0	0

n= number of cultured bacteria

Relationship between the peritoneal pus culture results and antibiotics administered

About two-thirds (64.4%) of the positive peritoneal pus culture results were sensitive to the preoperative antibiotics administered. About one-quarter (28.8%) of the preoperative antibiotics were changed due to the positive peritoneal pus aspirate culture results. The main reason for a change in antibiotics was due to the post-operative intra-abdominal collections demonstrated in 17 (23.3%) patients. Table 4 shows the relationship between the peritoneal pus aspirate culture result and the antibiotics administered.

Table 4: Peritoneal fluid culture results and outcomes (N=73)

Culture sensitivity results and outcomes	Variables	n (%)
Was the result sensitive to pre-operative antibiotics?	Yes	47 (64.4)
	No	26 (35.6)
Was the pre-operative antibiotics changed due to the culture results	Yes	21 (28.8)
	No	52 (71.2)
Reason for the change of antibiotics (in 21 the patients)	Intra-abdominal collections	17 (23.3)
	Wound infection	4 (5.5)
Was the pre-op antibiotics prolonged (>1 week – 4 weeks) due to the sensitivity?	Yes	21 (28.8)
	No	52 (71.2)
Prolonged duration of hospital stays due to complications of appendicitis	6-10 days	15 (20.5)
	11-15 days	6 (8.2)
Organisms causing change of antibiotics		
Streptococcus anginosus	Intra-abdominal collections	10 (13.7)
Psudomonas aeruginosa	Intra-abdominal collections	7 (9.6)
Streptococcus constellatus	Superficial wound infection	4 (5.5)
Antibiotics that were changed to after the culture results	Teicoplanin	14 (19.2)
	Ciprofloxacin	6 (8.2)
	Cotrimoxazole	1 (1.4)
Outcomes of the changed antibiotics	USS-guided drainage due to intra-abdominal collection (3-5cm)	2 (2.7)
	Re-operation due to intra-abdominal collection (6-10cm)	2 (2.7)
	No collection	13 (17.8)

Discussion

The study aimed to evaluate the impacts of the peritoneal pus aspirate culture results, the rational for the change of pre-operative antibiotics administered and the patients' surgical management outcomes following emergency appendicectomy in children. The mean age reported in this study was 10.6 ± 3.1 years. This age distribution is consistent with the known epidemiology of acute appendicitis in the paediatric and adolescent populations [6]. The male predominance observed in this study was also in line with the reported higher incidence of appendicitis in male compared to female children [7].

Most cases involved perforated appendicitis, indicating a high rate of complicated disease in the study cohort. This finding underscores the importance of prompt diagnosis and timely surgical intervention in paediatric appendicitis, as perforation can lead to significant morbidities and potential mortalities [8]. The choice of surgical approach, predominantly laparoscopic appendicectomy in this study, reflects the widespread adoption of minimally invasive surgical techniques in the management of appendicitis. Laparoscopic appendicectomy offers advantages such as reduced postoperative pain, faster recovery, and shorter hospital stays compared to open surgery [9]. However, only a small proportion of patients underwent open appendicectomy, which may have been necessitated by factors such as the presence of complex appendicitis [10].

In this study, nearly all patients received intravenous antibiotics combinations within 24 hours before surgery, reflecting adherence to standard guidelines for appendicitis management [10, 11]. However, it is noteworthy that a small proportion received antibiotics between 24 to 48 hours preoperatively, which could potentially impact the culture results and antibiotic sensitivities [11]. The purulent peritoneal fluid culture results revealed a high rate of positive cultures, indicating the presence of intra-abdominal infections in most cases despite the pre-operative intravenous antibiotics being administered. This finding is consistent with the high incidence of perforated appendicitis in the study population [12]. This suggests that purulent peritoneal fluid aspirate culture results during appendicectomy can help direct the use of targeted antibiotics and improve the overall patient outcomes and reduced longer hospital stay [12].

The predominant pathogens isolated from the peritoneal pus cultures were Escherichia coli and Streptococcus anginosus, as well as anaerobic bacteria like Bacteroides fragilis. These microbial findings are consistent with previous studies highlighting the predominance of gram-negative organisms in appendicitis-related infections [13-15]. The identified bacterial species and their antibiotic sensitivity patterns provided valuable insights into the local microbial flora and antibiotic resistance patterns.

Some studies have reported conflicting results regarding the utilisation of purulent peritoneal fluid cultures, with some studies, suggesting no significant impact on patients' management and surgical outcomes [16, 17].The results from this study seem to agree with other studies that have advocated for routine peritoneal pus aspirate for microbiology cultures, particularly in cases of complicated appendicitis, as it may aid in identifying resistant organisms and tailoring the antibiotic therapy [8,18] as 17.8% of the patients from this study avoided re-operation or ultrasound (USS)-guided drainage of intra-abdominal collections due to the changed antibiotics from the sensitivity patterns of the purulent peritoneal fluid aspirated during the surgical procedures.

The purulent peritoneal fluid aspirate for microbiology culture analysis could be seen to add an additional financial cost to the patients and the hospital; however, it is important to consider the potential benefits demonstrated in this study. In patients with uncomplicated appendicitis with prompt surgical interventions, empiric broad-spectrum antibiotics therapy may be sufficient, and peritoneal pus cultures may not significantly alter their post-operative management outcomes [19]. However, in patients with complicated appendicitis such as perforated appendicitis, or high-risk patients (e.g.,

immunocompromised), the purulent peritoneal fluid culture results could guide targeted antibiotics therapy and potentially improve the post-operative management outcomes [16].

Research and clinical implications:
The findings from this study will contribute to the understanding of the role of purulent peritoneal fluid aspirate microbiology culture results in paediatric acute appendicitis management. Therefore, changes of antibiotics based on culture results improved the overall surgical outcomes for those patients with intra-abdominal collections.

This study reports a rising prevalence of Streptococcus anginosus, as identified in microbiology cultures from multiple hospitals, associated with cases of complicated appendicitis. Therefore, prolonged course of antibiotics administrations to reduce the potential risks of intra-abdominal collections and other post-operative wound complications will be a strong argument for the routine purulent peritoneal fluid aspirates for microbiology culture especially in patients with complicated appendicitis.

Further study is needed to establish clear guidelines and criteria when the intra-operative purulent peritoneal fluid microbiology cultures should be obtained during appendicectomy, considering the local antimicrobial resistance patterns.

Strengths and limitations of the study
The key strength of this study is that it has provided insights into the microbial profile of intra-abdominal infection in paediatric acute appendicitis through the analysis of peritoneal pus aspirate culture results. This information is valuable for guiding the antibiotics selection and optimising treatment strategies based on the bacterial sensitivity patterns.

This study was carried out in a single hospital, which may limit the generalisability of the findings to other hospitals with different patient populations, antibiotics administration protocol, surgical practices, and microbiological profiles. Therefore, multi-centre studies involving diverse patient cohorts are needed to validate the findings and enhance external validity. The retrospective nature of the study design introduces inherent limitations therefore a prospective randomised study will provide robust evidence and validate the findings from this study.

Conclusions
This study has evaluated the usefulness of intra-operative purulent peritoneal fluid aspirates culture results during appendicectomy in children. The purulent peritoneal fluid culture results were useful in the post-operative management of some of the patients. Further research is needed to establish evidence-based guidelines for the appropriate use of intra-operative purulent peritoneal fluid culture results during appendicectomy.

Conflict of interest statement: The authors declare that they have no competing interests.

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