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PROFILE OF MICROORGANISM AND ANTIBIOTIC SENSITIVITY PATTERN IN PATIENTS UNDERGOING EMERGENCY LAPAROTOMY FOR PERITONITIS

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Abstract

Peritonitis is one of the common emergencies and multiple organisms have been implicated in the pathogenesis. Inappropriate and prolonged use of antibiotics have been attributed to the emergence of antibiotic resistance.

This is a retrospective observational study, from 1st January 2018 to 31st December 2019 (Two years). Patients with secondary peritonitis undergoing surgery are included in this study. Common pathogens and its antibiotic sensitivity pattern from peritoneal fluid, blood and surgical site were studied.

Perforation peritonitis is the most common cause of peritonitis. Cefaperazone-sulbactum and Piperacillin-tazobactum were the common empirical antibiotics prescribed. Escherichia coli followed by Klebsiella pneumonia were the commonest microorganism isolated from the peritoneal fluid and found to have adequate sensitivity for the empirical antibiotics. Enterococus and candida were the common organism isolated in blood culture. E-coli and Klebsiella from wound swab showed higher resistance to the empirical antibiotics. Large intestine perforation has higher percentage of surgical site infection.

E-coli and Klebsiella pneumoniae were the common cause of secondary peritonitis. The empirical antibiotic is shown to be sensitive to the common organism isolated from peritoneal cavity. Wound swab isolates have shown higher resistance to antibiotics hence isolating the organism and assessing the sensitivity might be prudent. Due to geographical variation of antibiotic resistance trends to microorganism, it is prudent to have antibiotic surveillance on a local basis that can recommend appropriate antibiotics.

Keywords: Peritonitis, Antibioitic resistance, Empirical antibiotics, Escherichia coli.

Introduction

Peritonitis is defined as the inflammation of the peritoneum and peritoneal cavity usually caused by localized or generalized infection. Classified in to three; **Primary**: Peritoneal infection resulting from haematogenous, lymphatic or bacterial translocation. **Secondary**: Peritoneal infection resulting in conjunction with inflammatory process of GI tract associated with microscopic or macroscopic perforation. **Tertiary**: Persistent or recurrent peritoneal infection developing after initial treatment of secondary peritonitis.

Peritonitis is one of the common emergencies encountered by the surgeons. There are multiple conditions responsible for secondary peritonitis including perforation peritonitis, appendicular perforation, mesenteric ischemia etc. The first case of peritonitis that was managed surgically in 19th century by McDowell due to an infected ovarian cyst [1]. The basic principle of surgical intervention involves source control of the infection. Peritonitis and its complications account for significant morbidity and mortality. The advent of modern critical care, newer antibiotics and diagnostic tools has improved the outcomes. In peritonitis multiple organisms enter the peritoneal cavity (gram positive, gram negative and anaerobic bacteria). E. coli is noted to be the commonest pathogen isolated. These pathogens are involved in causing inflammation and followed by activation of complement cascade. They also cause bacteraemia leading to sepsis and its sequela. Patients present during the various stages of natural history of the disease. Higher mortality is associated in patients presenting in sepsis. Therefore, early detection and timely

intervention has a proven benefit. There has been a rising trend of antibiotic resistance noted in multiple organisms encountered in secondary peritonitis. China and India has higher incidence of resistance of Enterobacteriaceae than the other countries in that region [2]. Multiple factors have been found to be responsible in the emergence of antibiotic resistance. The use of inappropriate antibiotics and its prolonged use has been attributed to drug resistance. Therefore, antibiotic stewardship is critical in tackling emergence of resistance. Due to considerable difference in the antibiotic resistance trends of various organisms based on the location, it is prudent to develop empirical antibiotic treatment regimens for each medical facility [3].

Aim Of Study

•Antibiotic sensitivity pattern of organisms involved in secondary peritonitis.
•Empirical antibiotics used and its adequacy.

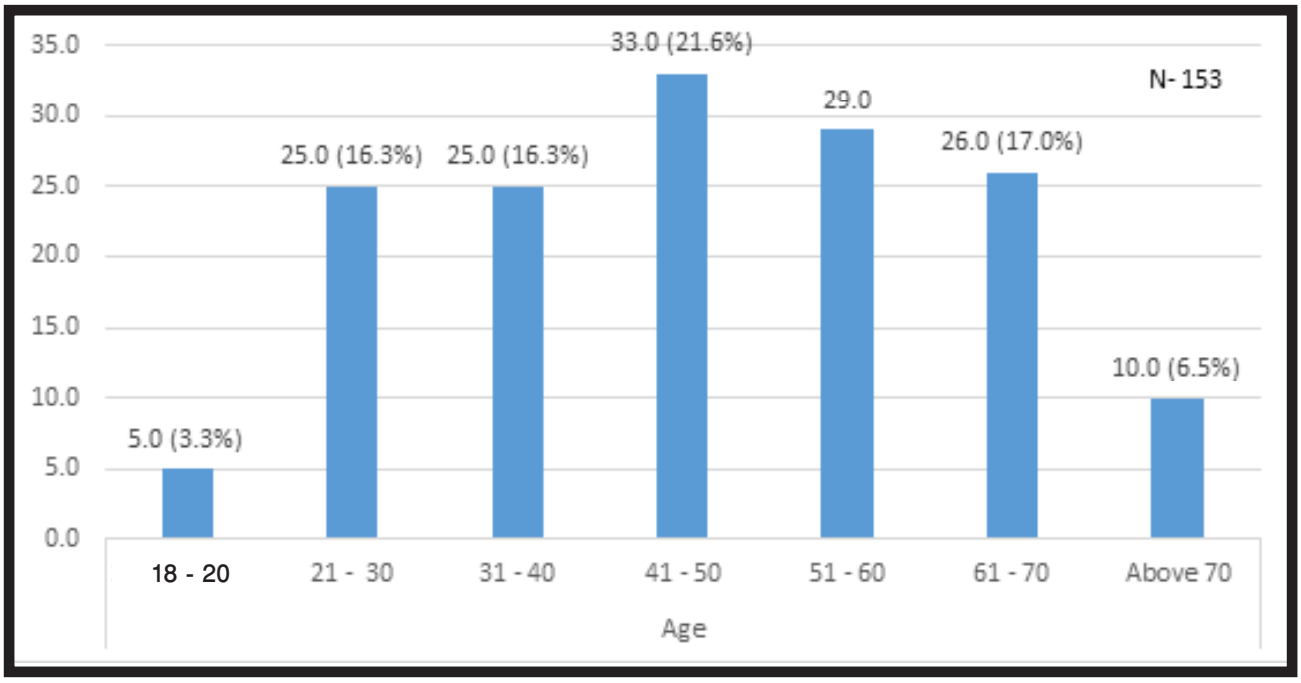
Patients & Methods

The study was conducted in the Department of General Surgery, Kasturba Hospital, Manipal.
Type of study: Retrospective observational study
Study period: 1st January 2018 to 31st December 2019
Study population: Patients presenting with secondary peritonitis undergoing surgery.
Institutional ethics committee clearance was obtained for the study.
Inclusion criteria:
•Above 18 years of age
•Patients with secondary peritonitis
•Patients undergoing exploratory laparotomy
Exclusion criteria:
•Patients with primary and tertiary peritonitis.
•Patients who underwent surgery for peritonitis at another hospital and referred to Kasturba hospital, Manipal for further management.
Method: Data of all patients presenting with secondary peritonitis undergoing surgery is collected from Medical records department at Kasturba hospital, Manipal.

Results

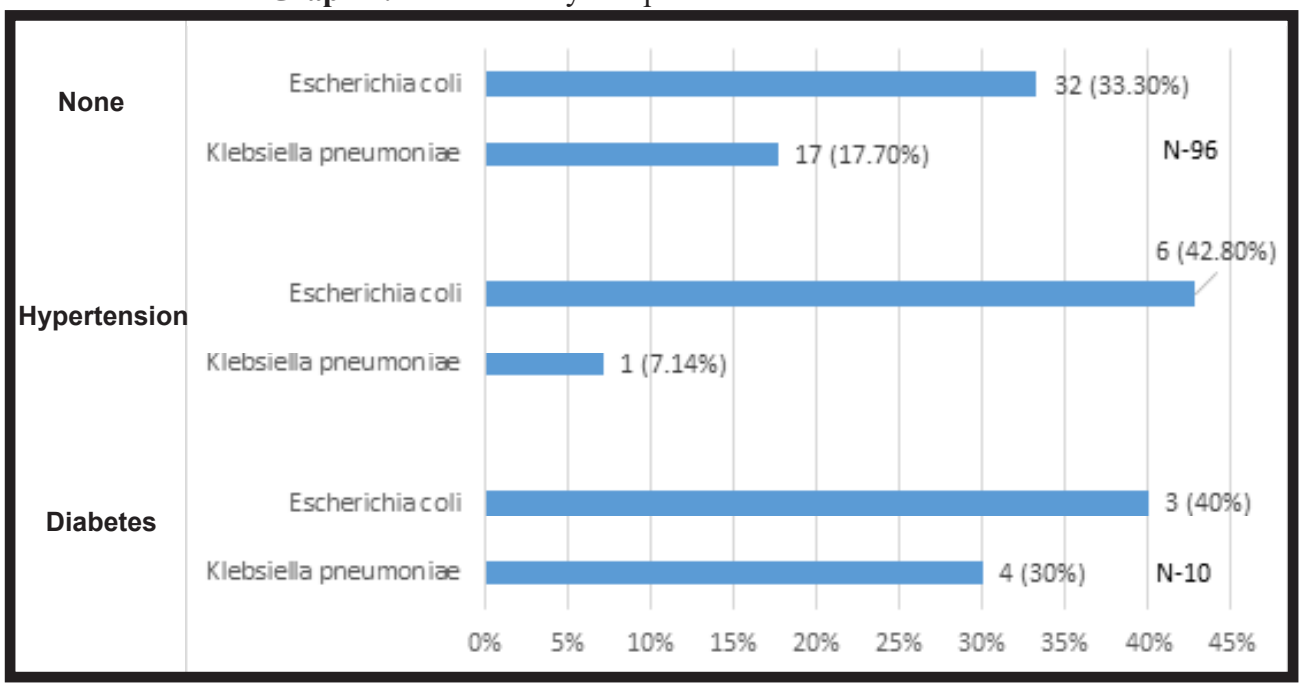
One hundred fifty one patients were included in this study and majority of the patients were male (79%) and in the age group 41-50 years (21.6%) (Graph 1).

Graph 1: Age distribution

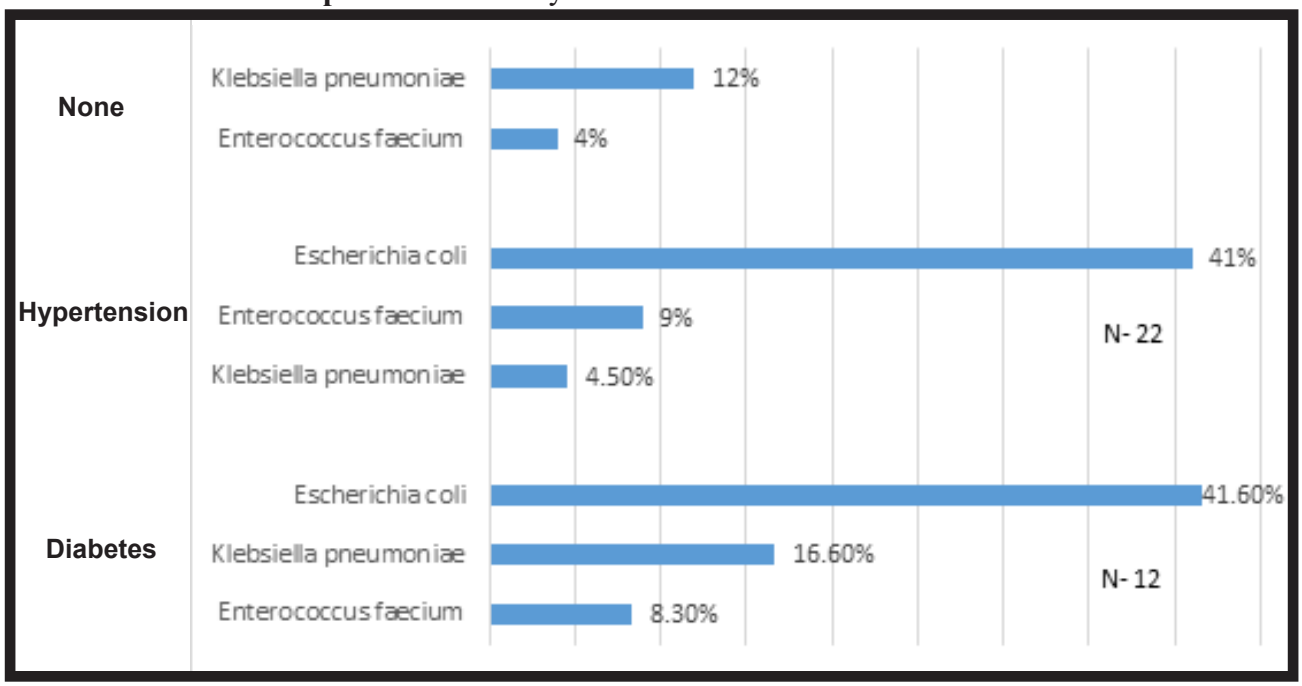


The most common complaint that the patient presented with was abdomen pain (98.7%). 66.7% of the patients did not have any comorbidities. Hypertension and diabetes were the leading comorbidities in our study population. On comparing the comorbidities with the peritoneal fluid isolates in cases of peritonitis, no correlation was noted (Graph 2). Similarly, no association was noted between the organism isolated from the wound swab and the comorbidities of the patient (Graph 3). The empirical antibiotic that was given most frequently in this study was cefaperazone-sulbactum (66%)

Graph 2: : Comorbidity and peritoneal fluid isolate association



Graph 3: Comorbidity and wound swab isolate association



followed by piperacillin-tazobactum (19%), in line with the recommendation from the hospital.

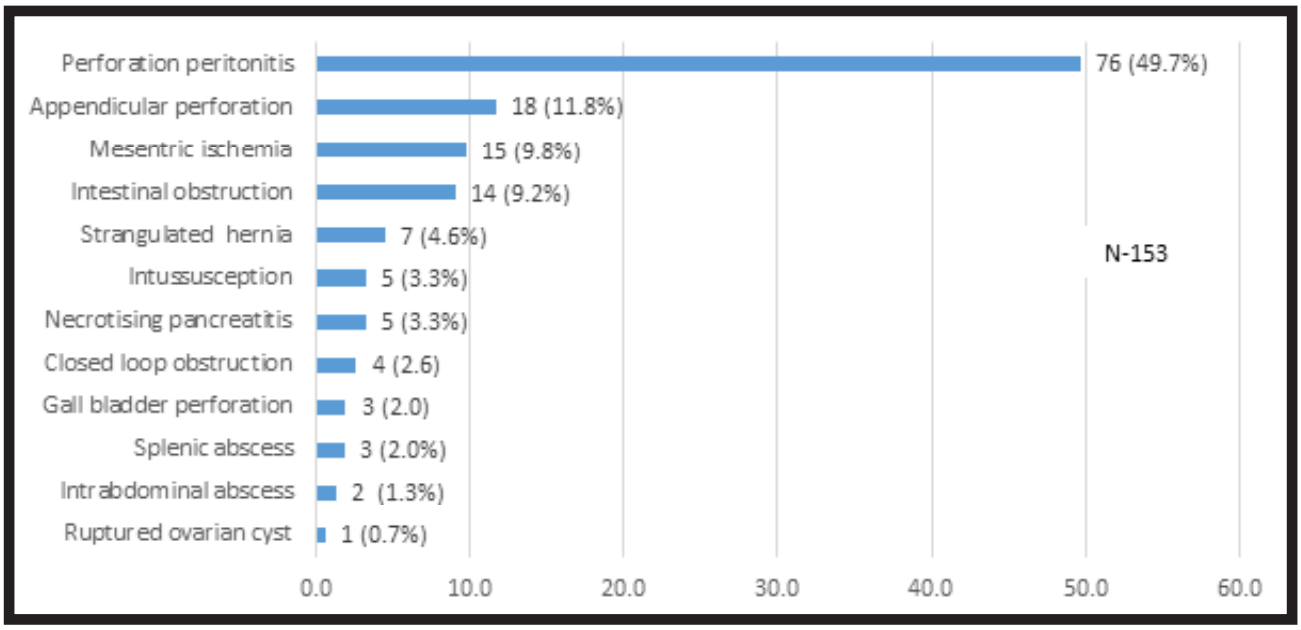
Diagnosis: Perforation peritonitis was the most common cause for peritonitis in this study (Graph 4). Appendicular perforation has been considered as a separate diagnosis since most cases were contained perforations and retrocaecal in nature with only a few progressing to generalised peritonitis. Gall bladder perforations were also considered separately as well since it is anatomically distinct from the gastrointestinal tract. Upper Gastrointestinal perforation along with small bowel perforations accounted for the 83% of the cases.

Cultures:

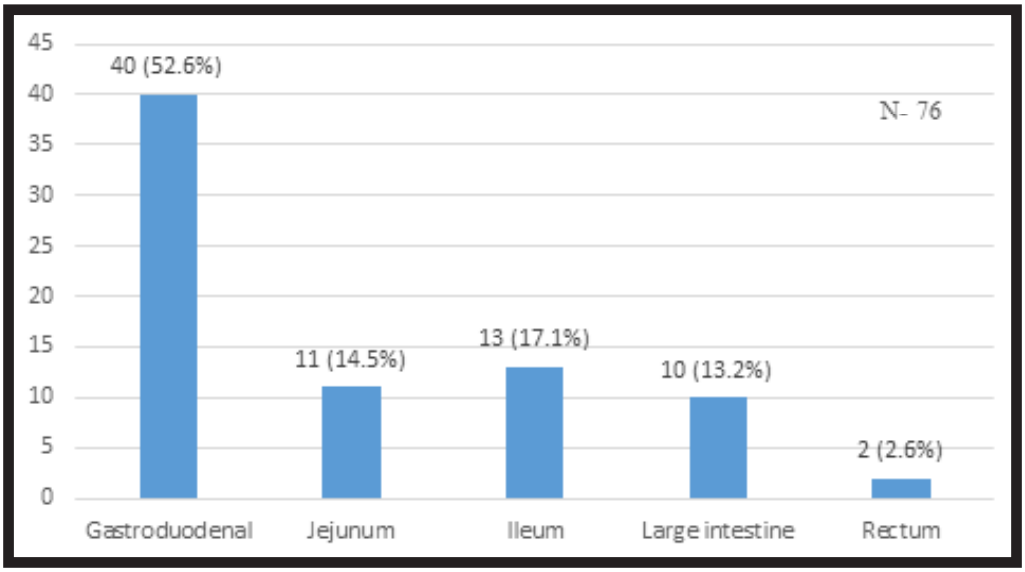
•128 blood cultures were assessed.
•127 peritoneal fluid isolates were assessed
•118 wound swabs isolates were assessed
•In 11 patients no cultures were send.

Peritoneal fluid: From the 70 samples that yielded positive cultures from the peritoneal fluid, E.coli followed by Klebsiella pneumonia were the most common organisms isolated (Graph 6).

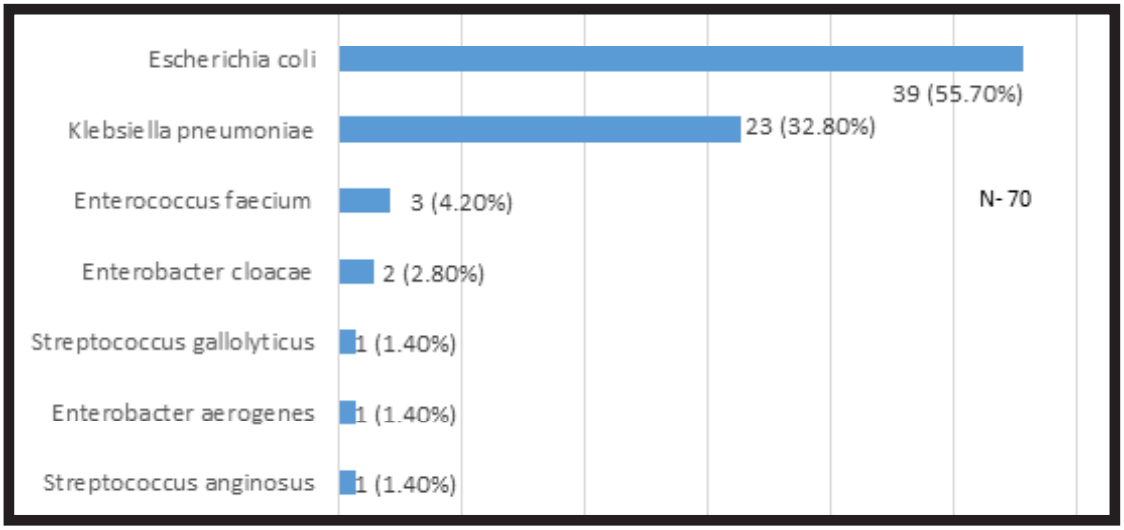
Graph 4: Diagnosis



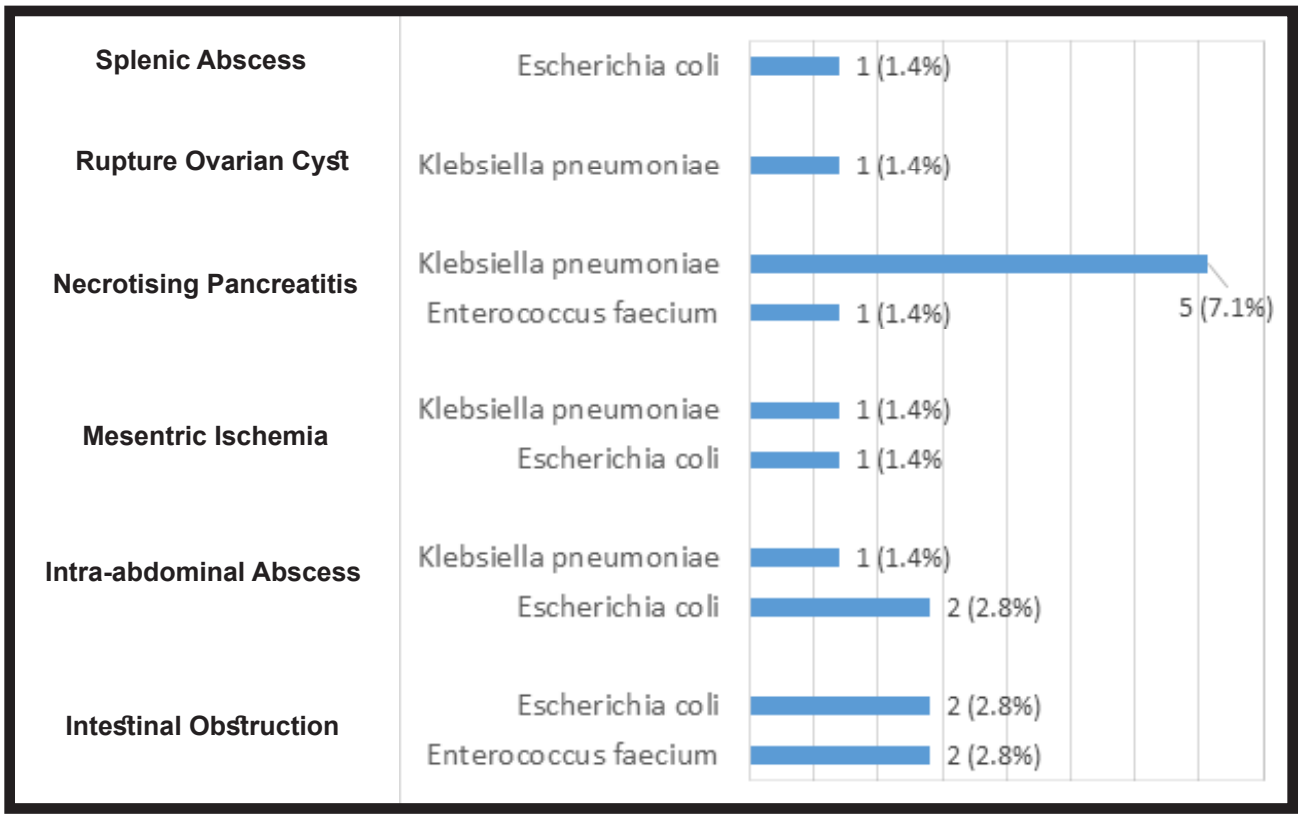
Graph 5: Distribution of perforation



Graph 6: Peritoneal fluid isolates

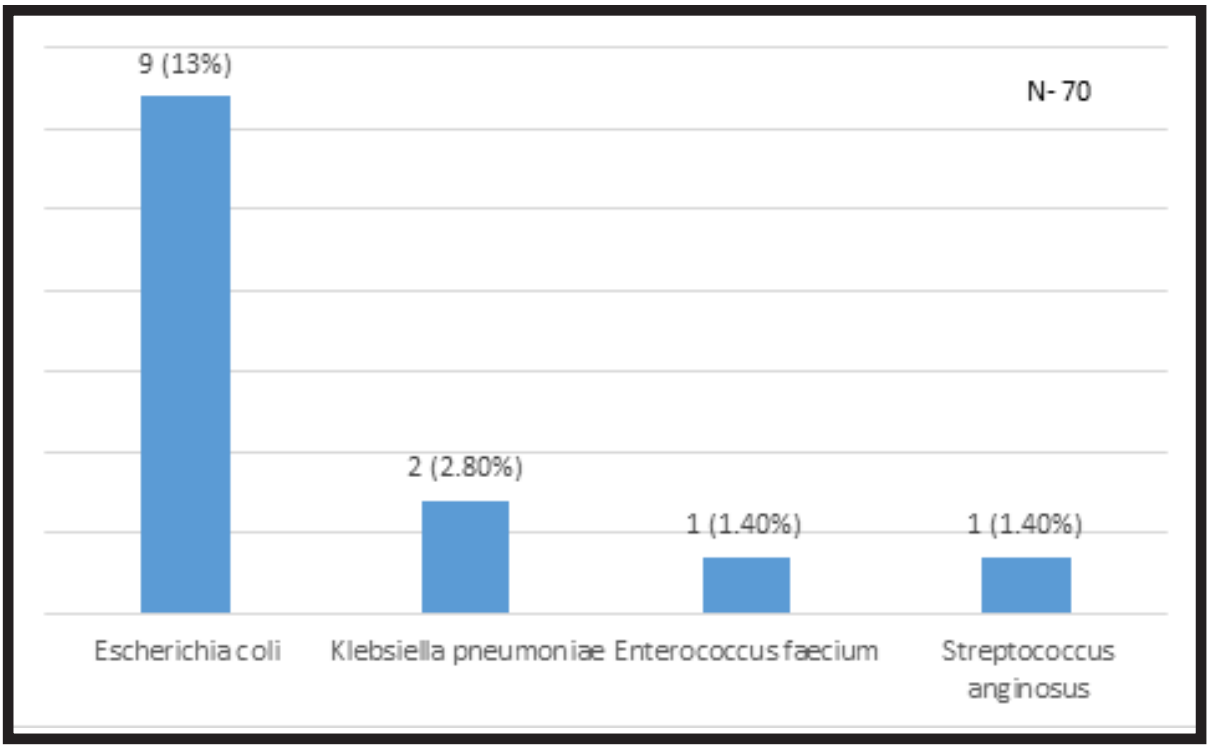


Graph 7: Common organism isolated from peritoneal fluid in various conditions



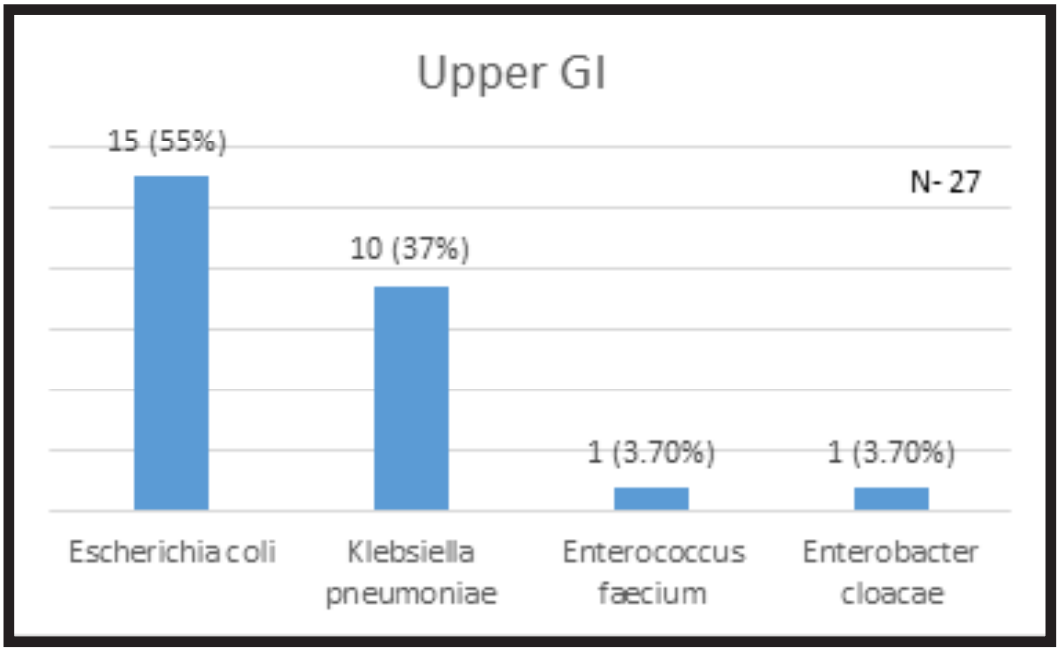
Thirteen cases of appendicular perforation yielded positive cultures from 18 cases of appendicular perforation. E. coli remained the commonest organism isolated from appendicular perforation (Graph 8).

Graph 8: Organisms isolated from peritoneal fluid in appendicular perforation

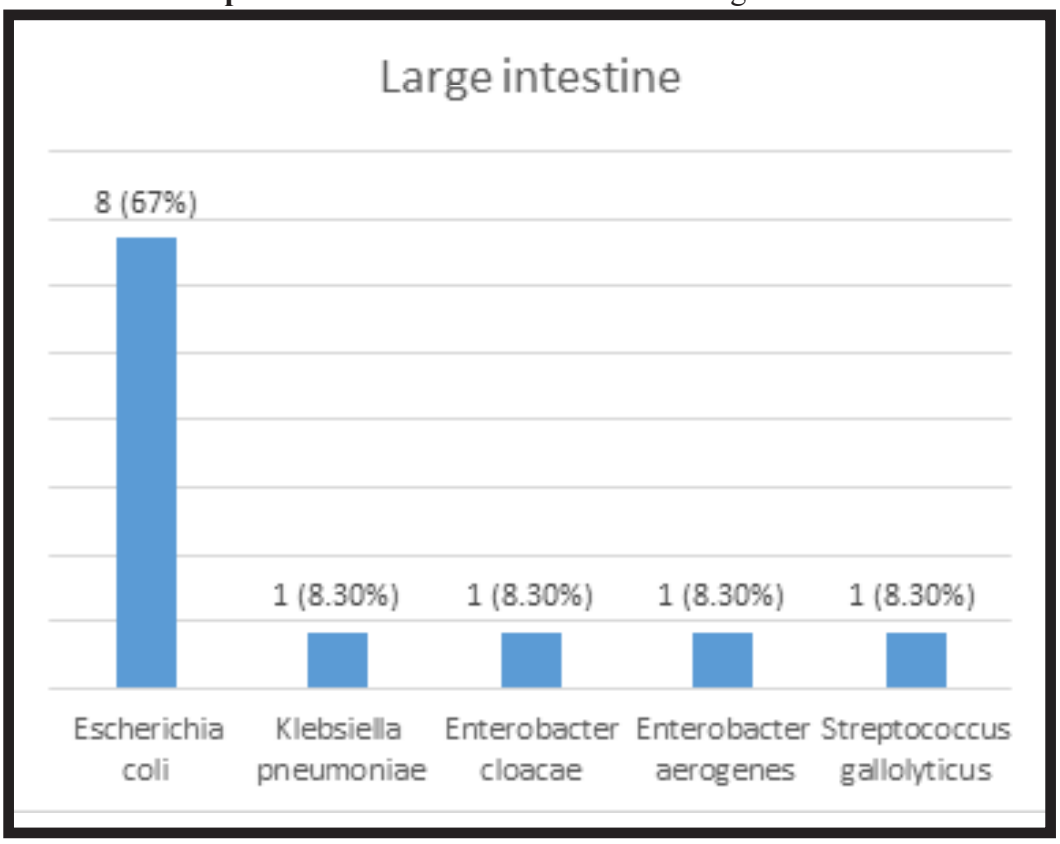


Higher association of E. coli isolates were seen in isolates from large intestine as compared to upper gastrointestinal perforation (Graph 9 & 10).

Graph 9: Peritoneal fluid isolates from Upper Gastrointestinal perforation (including small bowel)

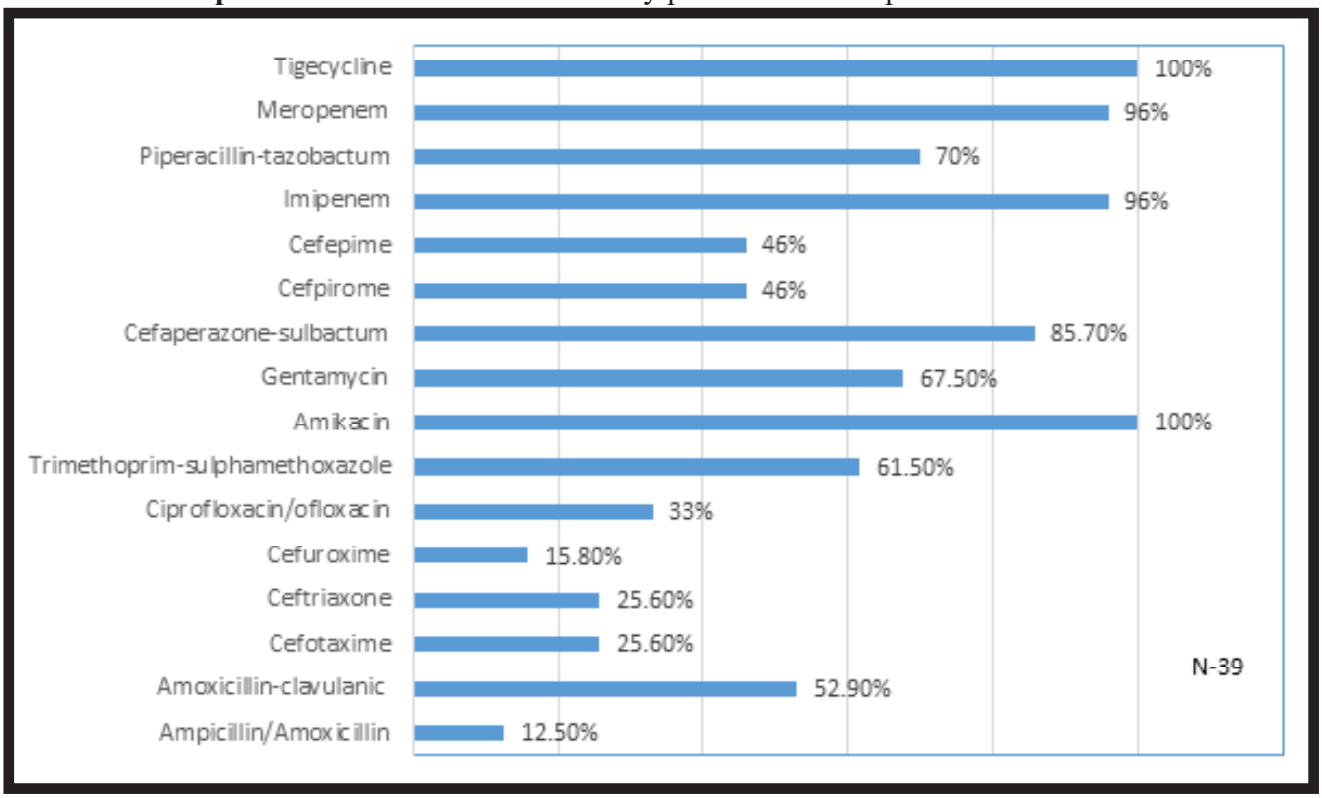


Graph 10: Peritoneal fluid isolates from large intestine

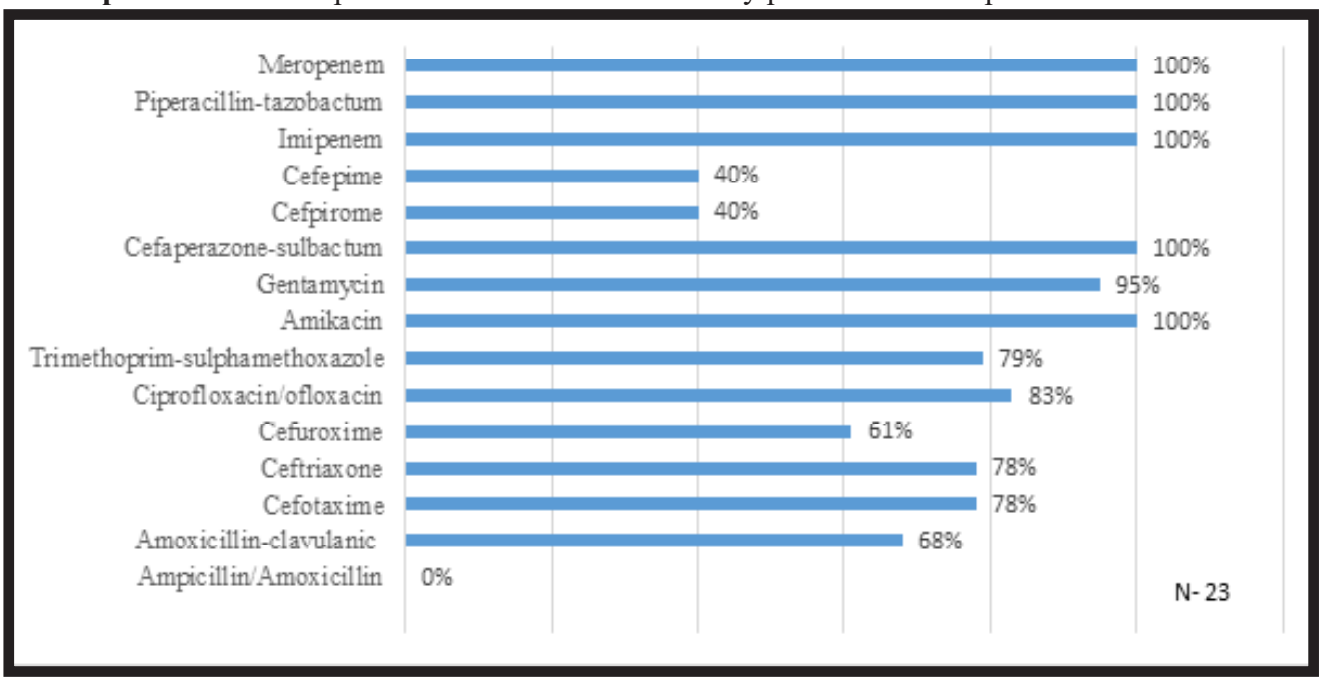


E. coli antibiotic sensitivity pattern based on 39 isolates from the peritoneal fluid has been described in graph 11. Antibiotic sensitivity pattern based on 23 samples of Klebsiella pneumoniae from peritoneal fluid has been elucidated in graph 12.

Graph 11: E. coli antibiotic sensitivity pattern based on peritoneal fluid isolates



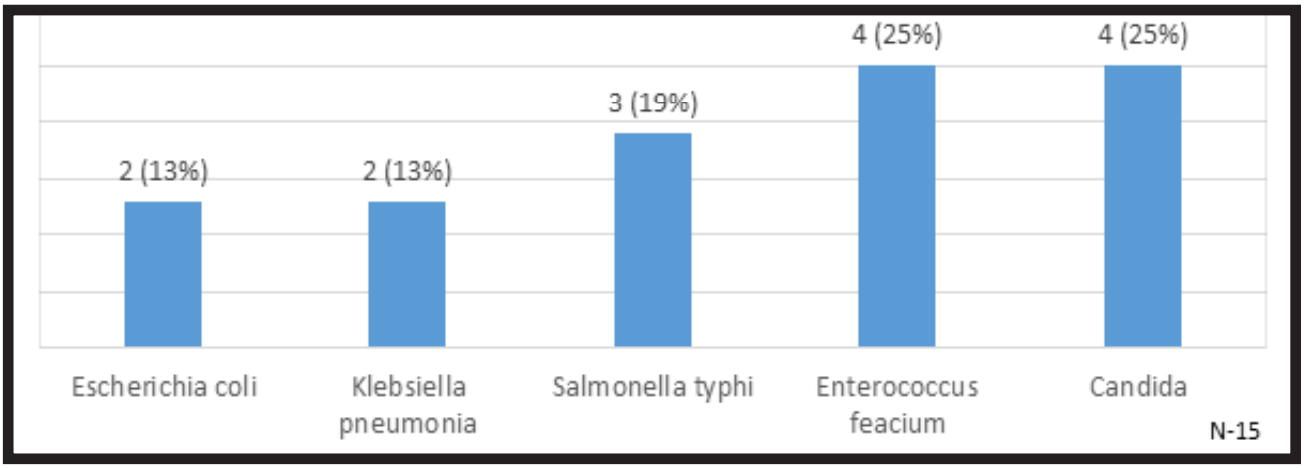
Graph 12: Klebsiella pneumoniae antibiotic sensitivity pattern based on peritoneal fluid isolates



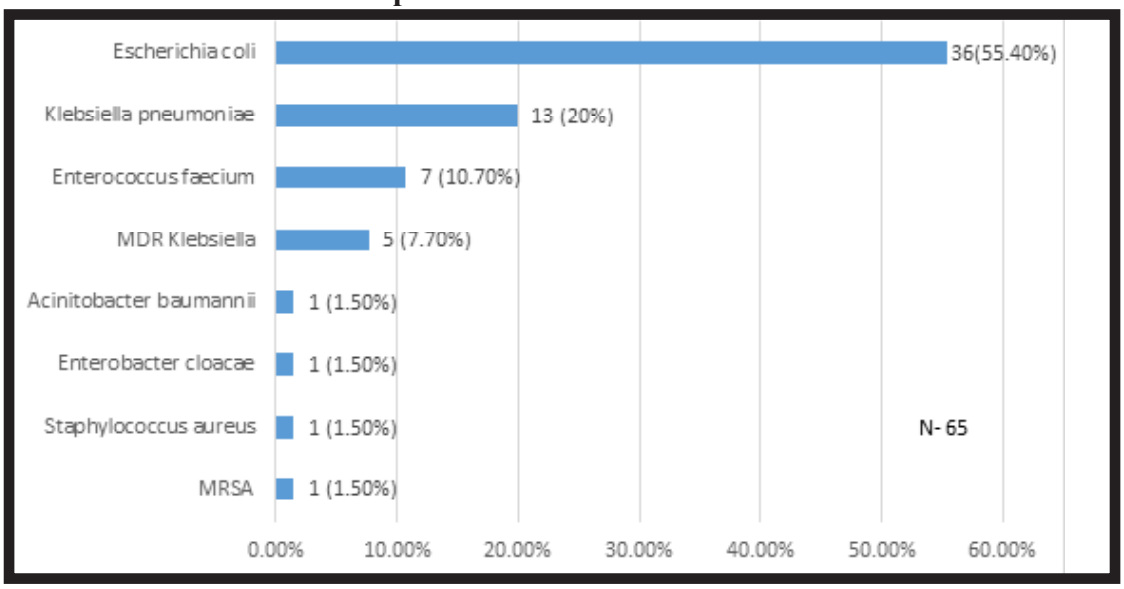
Blood culture: Out of 128 samples analysed, only 22 were shown to have pathogen. Fifteen positive isolates were present in cases of perforation peritonitis. Enterococcus and candida were the common organism isolated from blood in cases on perforation peritonitis (Graph 13). This might be explained in some patients since the samples were send during the post-operative period.

Wound swab: From the 118 samples send, 65 yielded positive isolates (Graph 14). Thirty-Six isolates of E. coli from the wound swab were analysed to form the antibiotic sensitivity pattern. There is higher resistance to cefaperazone – sulbactum, piperacillin – tazobactum and fluoroquinolones in the wound swab isolate of E. coli compared to the peritoneal fluid (Graph 15).

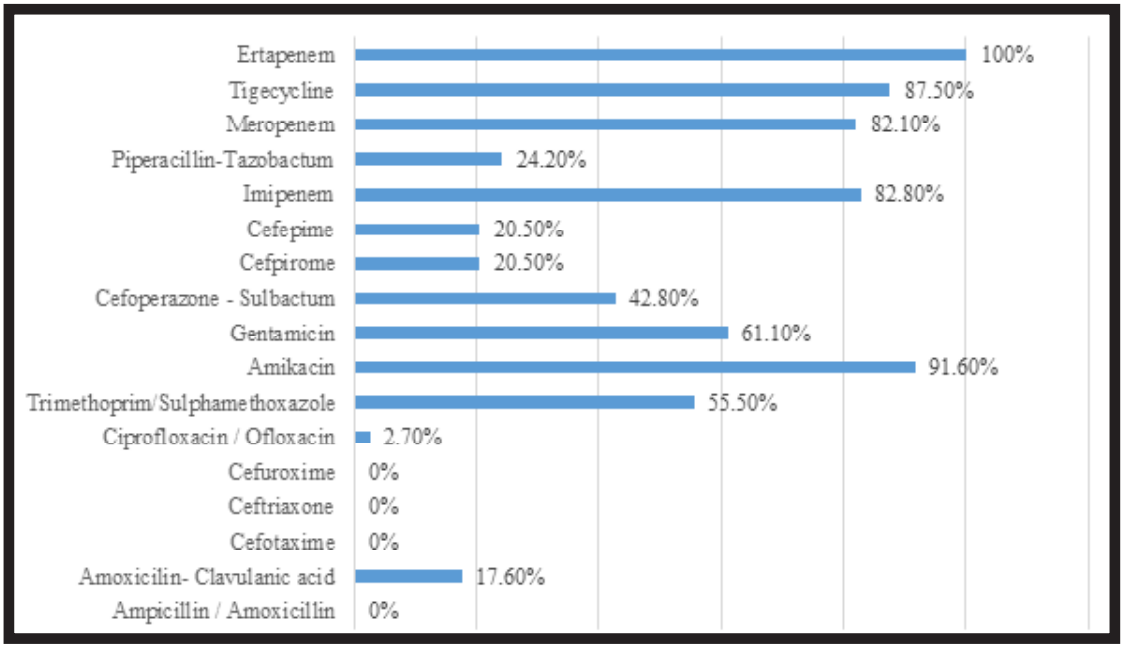
Graph 13: Blood culture organisms in perforation peritonitis



Graph 14: Wound swab isolate



Graph 15: : E. coli antibiotic sensitivity pattern based on wound swab isolates



Similarly, higher resistance to cerfoperazone – sulbactum and piperacillin – tazobactum in the wound swab isolate of Klebsiella compared to the peritoneal fluid isolate (Graph 16). Fluoroquino-

Graph 16: Klebsiella pneumoniae antibiotic sensitivity pattern based on wound swab isolate

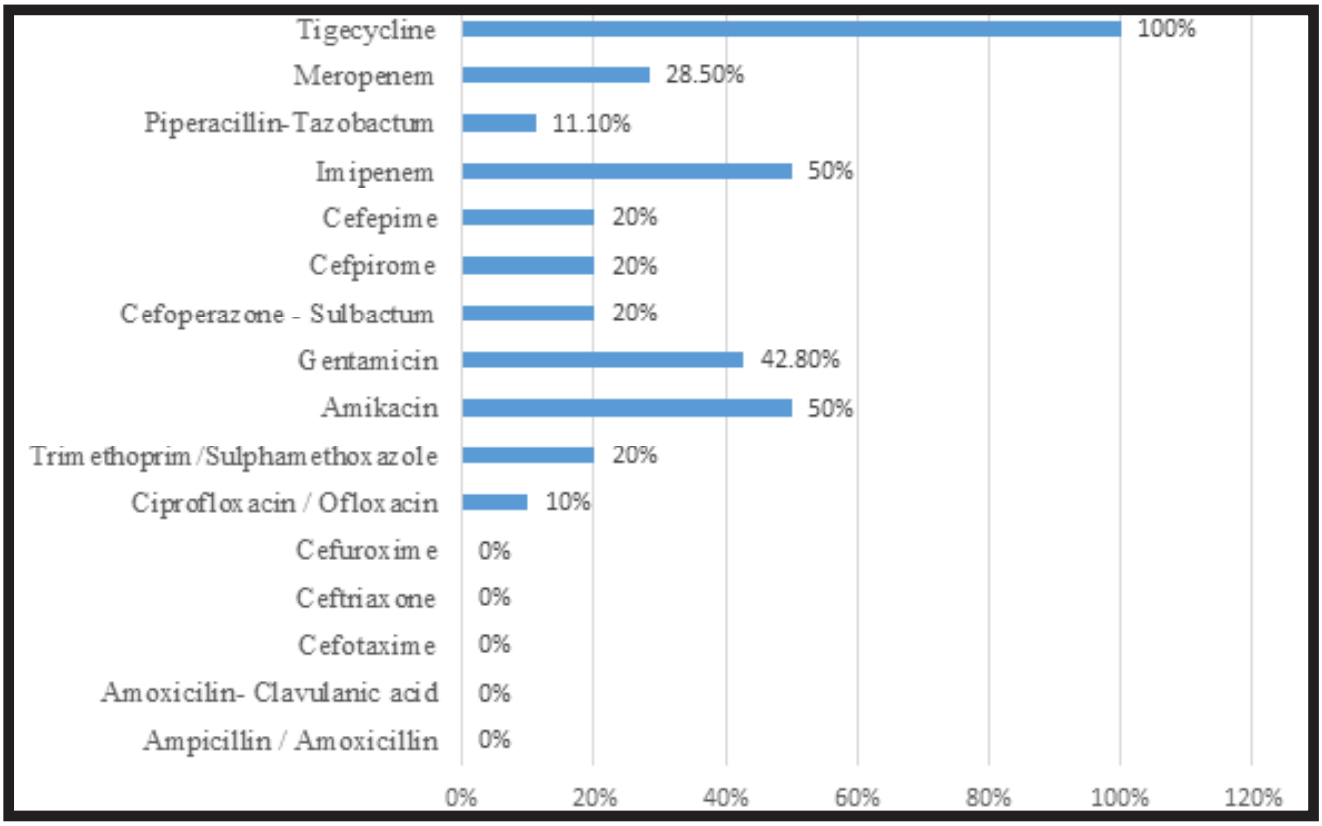


Table 1: Type of comorbidities

COMORBIDITIES	COUNT	PERCENTAGE
Hypertension	24	13.8
Diabetes	15	8.6
Ischemic heart disease	7	4.0
Chronic liver disease	3	1.7
COPD	3	1.7
Bronchial asthma	2	1.1
Tuberculosis	2	1.1
Hypothyroidism	2	1.1
Hepatitis B	1	0.5
Hepatocellular cancer	1	0.5
Chronic myeloid leukaemia	1	0.5
HIV	1	0.5
Atrial fibrillation	1	0.5
Benign prostatic hyperplasia	1	0.5
Nephrotic syndrome	1	0.5
Polycythemia vera	1	0.5
Portal hypertension	1	0.5
Splenic vein thrombosis	1	0.5
Rheumatic heart disease	1	0.5
Ulcerative colitis	1	0.5
Vasculitis	1	0.5
Cerebrovascular accident	1	0.5

Table 2: Cultures

		COUNT	PERCENTAGE
BLOOD CULTURE	Positive	22	17.2
	Negative	106	82.8
	Total	128	100
PERITONEAL FLUID	Positive	70	55.1
	Negative	57	44.8
	Total	127	100
WOUND SWAB	Positive	65	55.1
	Negative	53	44.9
	Total	118	100

Table 3: Association of blood culture organism with mortality

ORGANISM	COUNT	PERCENTAGE
Burkholderia cepacia	1	5.5
Candida subliniensis	1	5.5
Escherichia coli	1	5.5
Klebsiella pneumoniae	1	5.5
Contaminant	3	16.6
No growth	11	61.1

Table 4: Site of perforation in cases of mortality

SITE OF PERFORATION	COUNT	PERCENTAGE
Gastroduodenal	4	50
Jejunum	1	12.5
Ileum	2	25
Large intestine	1	12.5
Total	8	100

Table 5: Wound swab in cases of mortality

ORGANISM	COUNT	PERCENTAGE
Acinitobacter baumannii	1	14.3
Enterobacter cloacae	1	14.3
Escherichia coli	1	14.4
Klebsiella pneumoniae	2	28.5
Contaminant	1	14.3
No growth	1	14.3
Total	7	100

Table 6: Site of perforation in cases of surgical site infection

SITE OF PERFORATION	COUNT	PERCENTAGE
Gastroduodenal	14	45.1
Jejunum	4	12.9
Ileum	8	25.8
Large intestine	8	25.8
Total	31	100

lones and aminoglycosides are also noted to have higher resistance as compared to the peritoneal fluid isolate.

Mortality: Thirteen cases of mortality were noted in the study population. Majority of the mortality occurred in the age group of 61-70 years (33.3%) and did not suffer from any comorbidities (37.5%). 18 blood culture samples were send in 13 cases of mortality. Perforation peritonitis accounted for 8 of the 13 cases of mortality. The other causes were mesenteric ischemia, intestinal obstruction and strangulated umbilical hernia. E coli and Klebsiella pneumoniae were the only organisms isolated from the peritoneal fluid in this cases . In each case, no organism isolated from the blood.

Surgical site infection: Sixty three patients suffered from surgical site infection with the majority in the age group 41-50 years (22.2%). Most patients did not suffer from any comorbidity in this group (59.7%). Perforation peritonitis accounts for 31 cases of the 63 cases of surgical site infection. Large intestine perforation has higher percentage of SSI compared to gastroduodenal perforation. E. coli and Klebsiella pneumoniae were the most common organism isolated from the peritoneal fluid in this cohort (table 7).

Table 7: Peritoneal fluid organism involved in cases of surgical site infection

ORGANISM	COUNT	PERCENTAGE
Escherichia coli	23	42.6
Klebsiella pneumoniae	9	16.6
Enterococcus faecium	1	1.9
No growth	21	38.9
Total	54	100

Table 8: Organism in peritoneal fluid in patients with post-operative fever

ORGANISM	COUNT	PERCENTAGE
Escherichia coli	11	40.7
Klebsiella pneumoniae	5	18.5
Enterobacter aerogenes	1	3.7
Streptococcus gallolyticus	1	3.7
No growth	9	33.3
Total	27	100

Post-operative fever: 28 patients had post-operative fever. Patients with post-operative fever did not have any association with any particular organism in blood culture.

Table 9: Organism in wound swab in patients with post-operative fever

ORGANISM	COUNT	PERCENTAGE
Escherichia coli	9	28.1
Klebsiella pneumoniae	5	15.6
Enterococcus faecium	2	6.2
Contaminant	2	6.2
No growth	14	43.8
Total	32	100

Table 10: Comparison of demographic patternties

STUDY	TYPE OF STUDY/ CENTRES	NO. OF PATIENTS/ STUDY PERIOD	AGE / Age group in years	MALE	FEMALE
Pritish John Korula [4]	Retrospective Single centre	117 2014-15	44.9	75.2%	24.8%
Praveen Kumar [5]	Prospective Single centre	77 2018	43.1 ± 18.9	76.6%	23.4%
Rajeshwara K. V [7]	Retrospective Single centre	105 2010-13	61-70	74.2%	25.7%
Vishnu Prasad [6]	Prospective Single centre	352 2005-06	44	87.5%	12.5%
Partha Sarathi Ghosh [8]	Prospective Single centre	545 2008-11	31.9	95%	5%
Rajender Singh Jhobta [9]	Retrospective Single centre	504 2002-06	36.8	84%	16%
Present study	Retrospective Single centre	153 2018-19	41-50	79%	21%

Table 11: Comparison of clinical profile

STUDY	COMORBIDITY	SYMPTOMS	SITE OF PERFORATION
Pritish John Korula [4]	-	-	Gastroduodenal (43.5%)
Praveen Kumar [5]	-	-	Lower gastrointestinal (50.6%)
Rajeshwara K. V [7]	-	Pain abdomen (77%) Vomiting (39%)	Gastroduodenal (71%)
Vishnu Prasad [6]	-	Pain abdomen > Abdominal distension (71%)	Gastroduodenal (51%)
Partha Sarathi Ghosh [8]	None>hypertension (10.2%)	Pain abdomen (98%) > Vomiting (59%)	Gastroduodenal (48.4%)
Rajender Singh Jhobta [9]	None > Respiratory disease (10%)		Gastroduodenal (65%)
Present study	None> hypertension (13.8%)	Pain abdomen (98%) > Vomiting (49%)	Gastroduodenal (52.6%)

Table 12: Comparison of microbiological profile

STUDY	EMPIRICAL ANTIBIOTIC	PERITONEAL FLUID CULTURE POSITIVITY	MOST COMMON ORGANISM	SENSITIVITY
Pritish John Korula [4]	Piperacillin-tazobactum, Cefoperazone-sulbactum	65%	E. coli (14.6%)	-
Praveen Kumar [5]	Cefoperazone-sulbactum (38.6%) Piperacillin-taxobactum (29.3%)	50%	E. coli (47.9%) K. pneumoniae (12.5%)	Amikacin: 95%, cefoperazone-sulbactum:55%, piperacillin-tazobactum:65%, imipenem: 95%
Vishnu Prasad [6]	Ampicillin+Gentamycin +Metronidazole (66.4%)	64%	E. coli (34.4%) K. pneumoniae	Ampicilin: 12%, Amikacin: 94%, Ceftriaxone: 36%, Ciprofloxacin: 17%, Gentamycin: 17%
Present study	Cefoperazone-sulbactum (66%)	55.1%	E. coli (55.7%) K. pneumoniae (32.8%)	Piperacillin-tazobactum: 70%, cefaperazone-sulbactum: 85%, Amikacin: 100%, Ampicillin: 12.5%

Table 13: Comparison of mortality and SSI

STUDY	MORTALITY	SURGICAL SITE INFECTION
Pritish John Korula [4]	18.8%	
Praveen Kumar [5]	32.5%	
Rajeshwara K. V [7]	0.9%	30.4%
Vishnu Prasad [6]	16.5%	
Partha Sarathi Ghosh [8]	8.4%	36.5%
Rajender Singh Jhobta [9]	10%	25%
Present study	13%	41%

Discussion

This study showed middle aged male preponderance in secondary peritonitis with 79% being male between the age group of 41-50 years (21.6%). This was consistent across other studies [4-6]. Abdominal pain was a universal symptom that was seen in all studies consistently. There is no association of peritonitis with comorbidities as seen in other studies as well. Most common site of perforation in our study was noted to be gastroduodenal (43.5%). Proximal gastrointestinal perforation is quite widely reported in India [4,6–9]. Higher incidence can be secondary to peptic ulcers. There is considerable reduction in the incidence of gastroduodenal perforation in the western population, which could be accounted to adequate detection and treatment of peptic ulcers [10,11]. One study noted lower gastrointestinal perforation as the most common cause [5]. This may be due to the relatively smaller sample size of 77 patients. Appendicular perforations may have been considered along with ileal perforations which may have contributed to the higher incidence of higher gastrointestinal perforation in the study. In our study, appendicular perforation is the second most common aetiology for peritonitis following gastroduodenal perforation.

The most common empirical antibiotic started in our study was cefoperazone – sulbactum (66%) followed by piperacillin – tazobactum (19%). Most common isolate from the peritoneal fluid is noted to be E. coli which was consistent across all studies. In our study there is E. coli is noted to have adequate sensitivity to Cefoperazone – sulbactum as well as piperacillin – tazobactum. As per hospital antibiotic policy Cefoperazone-sulbactum and piperacillin-tazobactum are the recommended antibiotics in cases of secondary peritonitis. The empirical antibiotic is noted to have good activity against the common organism (E. coli and K. pneumoniae). Study conducted Vishnu Prasad et al has reported ampicillin, gentamycin and metronidazole being used as the empirical antibiotic though there is higher resistance noted to the said agents [6]. Our study has also shown higher resistance to ampicillin in E. coli isolated from peritoneal fluid. In a recent study ESBL strains have been reported in 53% of isolates [2] which is a worrying trend in antibiotic resistance.

Mortality rates among different study is shown to vary based on the late presentation of the patient and the services available at the treating centre. The mortality rate in our study was 13% and there was no association with organism isolated from the blood or peritoneal fluid. In one study isolation of enterococcus from the peritoneal fluid was associated with poor outcomes [6]. Our study noted higher surgical site infection in patients due to late presentation of the patients with gross contamination of the abdominal cavity. The wound swab isolates have noted to grow E. coli and K. pneumoniae with higher resistance to the drugs. They might be involved in causing significant morbidity in the patient. In the cases of mortality, no organism isolated from the blood corresponded with the peritoneal fluid isolates in our study.

Conclusion

E. coli and K. pneumoniae were the common cause of secondary peritonitis. Gastroduodenal perforation is the commonest cause of perforation peritonitis. The empirical antibiotic (cefaperazone- sulbactum and piperacillin – tazobactum) is shown to be effective against the common organism isolated in cases of secondary peritonitis on organisms from peritoneal cavity and wound swab in cases of secondary peritonitis. Wound swab isolates have shown higher resistance to various antibiotics. Therefore, in cases of surgical site infection isolating the organism and assessing the sensitivity might be prudent. E. coli has shown good sensitivity to carbapenems, aminoglycoside, cefaperazone – sulbactum and piperacillin – tazobactum. Higher resistance is noted in fluoroquinolones, penicillin and second generation cephalosporin. Due to geographical variation of resistance trends among various organisms, it is prudent to have antibiotic surveillance on a local basis that can recommend appropriate antibiotics.

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