Original Research Article

Clinical efficacy of two anti-microbials (ceftriaxone and metronidazole) versus three antimicrobials (ceftriaxone, metronidazole and amikacin) in perforative peritonitis

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ABSTRACT

Background: Peritonitis is classified as primary, secondary and tertiary. In primary peritonitis and continuous ambulatory peritoneal dialysis-associated peritonitis, the source of the infection is not due a breach in the gastrointestinal tract and usually caused by a single organism. Secondary peritonitis ensues, which may be localized and contained or diffuse carrying a high mortality in the absence of surgical intervention and appropriate antimicrobial therapy. In contrast, secondary peritonitis following perforation of the gastrointestinal tract or an infection originating in an intra-abdominal structure. Tertiary peritonitis is an ill-defined entity, which occurs despite adequate treatment of primary or secondary peritonitis.

Methods: This is a prospective clinical study conducted on 140 consecutive patients who presented to the surgical department of RL Jalappa Hospital and Research Centre, Tamaka, Kolar with peritonitis secondary to hollow viscus perforation.

Results: A total of 140 patients who presented with peritonitis secondary to hollow viscus perforation, admitted and treated in RL Jalappa Hospital and Research Centre attached to Sri Devaraj Urs Medical College, Kolar were studied during the period of December 2015 to June 2017.There was decrease in postoperative complications and hospital stay in Group B.

Conclusions: In present study peritonitis is more common in men compared to women. The most common age group is in between 21-40 years in cases of peritonitis with the mean age of 37 years. Duodenal ulcer perforation is the commonest site of perforation. Escherichia coli is the most common organism isolated in the peritoneal fluid. usage of three antimicrobials ($p<0.05$) is beneficial in reduction in postoperative complications and hospital stay when compared to usage of two antimicrobials which is statistically significant.

Keywords: Amikacin, Ceftriaxone, Metronidazole, Perforative peritonitis, Postoperative complications and Hospital stay

INTRODUCTION

Peritonitis presents most commonly due to the localized or generalized infection caused from various factors. Secondary peritonitis is the most common form that follows an intraperitoneal source usually from perforation of hollow viscera. Acute generalized peritonitis due to underlying hollow viscus perforation is a critical and life-threatening condition. It is a common surgical emergency in most of the general surgical units across the world.[1]

The rate of secondary infection is higher as majority of patients being from rural areas, present late to the hospital due to low awareness, local beliefs and faith in native medicine. It is often associated with significant morbidity and mortality.[2]

The study aims to compare the efficacy of two antimicrobials (Ceftriaxone and Metronidazole) and three antimicrobials (Ceftriaxone, Metronidazole and Amikacin) in perforative peritonitis and to ensure adequate control of infection and to decrease the chances of post-operative wound infection thereby preventing prolonged hospital stay.

The multifaceted nature of abdominal surgical infections makes it difficult to precisely define the disease and to assess its severity and therapeutic progress. Both the anatomic source of infection and to a greater degree, the physiologic compromise it inflicts affects the outcome.

Perforation of an intra-abdominal hollow organ with spillage of contents into the peritoneal cavity always leads to severe pain, shock, sepsis and a high risk of death. However, in posterior perforation, the features are less dramatic.[3]

According the various studies on the pathology of peritonitis, the pathogenesis of perforative peritonitis is mainly based on the local and systemic release of pro and anti-inflammatory mediators triggered by the presence of bacteria and their products in the abdominal cavity. Therefore, treatment consists of preoperative initiation of broad-spectrum antibiotic therapy, focal restoration, intraoperative debridement and lavage.[4]

Closure of perforation with a thorough peritoneal wash under systemic antibiotic coverage has been the important step in managing peritonitis, which is practiced now-a-days. In cases of small intestinal perforation, resection anastomosis can be performed.[5]

High-risk patients require timely and aggressive treatment especially in severe peritonitis. Early prognostic evaluation is desirable so as to be able to select high-risk patients for more aggressive treatment especially in severe peritonitis.

The prognosis and outcome of peritonitis depend upon the interaction of several factors, which includes patient-related factors, disease-specific factors, diagnostic and therapeutic interventions.[6]

According to Surgical Infections Society and the Infection Diseases Society of American guidelines, "an Antimicrobial therapy for an established infection should be continued until resolution of clinical signs of infection occurs, including normalization of temperature and white blood cell count and return to gastrointestinal function". In most trials involving antibiotic therapy, an arbitrarily fixed period ranging from 5 to 14 days is used for all patients with intraabdominal infections, irrespective of the severity of peritonitis.[7]

Objectives

- To assess the efficacy of two antimicrobials (Ceftriaxone and Metronidazole) in perforative peritonitis.
- To assess the efficacy of three Antimicrobial (Ceftriaxone, Metronidazole and Amikacin) in perforative peritonitis.
- To compare the clinical outcome of perforative peritonitis with two and antimicrobials in the terms of reduction in postoperative hospital stay and infections.

METHODS

This is a prospective clinical study conducted on 140 consecutive patients who presented to the surgical department of RL Jalappa Hospital and Research Centre, Tamaka, Kolar with peritonitis secondary to hollow viscus perforation.

The study period was from December 2015 to June 2017. This was a randomized study and all the patients were divided in two groups.

Group A: Patients with all odd serial numbers were included in this group and treated with two antimicrobials (Inj. Ceftriaxone 1gm IV BD and Inj. Metronidazole 500mg IV TID).

Group B: Patients with all even serial numbers were included in this group and treated with three antimicrobials (Inj. Ceftriaxone 1gm IV BD, Inj Metronidazole 500mg IV TID and Inj. Amikacin 500mg IV BD).

Methods of collection of data

All patients who presented with features of peritionitis secondary to hollow viscus perforation fulfilling the inclusion criteria were included in the study.

Patient's details like history, clinical examination and investigations were documented using a standard proforma designed for the study.

Pre-operative preparation

All the patients were optimised before surgery by correction of shock, electrolyte imbalance and dehydration. Broad spectrum antibiotic coverage (Ceftriaxone and Metronidazole or Ceftriaxone, Metronidazole and Amikacin) were started preoperatively and continued in the post-operative period. Tetanus prophylaxis was given at the time of presentation. Two drugs/ three drugs were initiated depending upon which group the patient is included.

Operative details

At laparotomy, peritoneal contaminated fluid was collected for culture and sensitivity and operative findings such as the site of perforation, degree of peritoneal contamination was recorded. After appropriate surgery was done (appendicectomy, closure of perforation/ Grahm's omental patch repair, resection and anastomosis (Rand A)) thorough wash was given to the peritoneal cavity with normal saline.

Post operatively, the patients were followed up on third, fifth, seventh day and subsequently after one month and following parameters were recorded like development of the local and systemic complications and duration of hospital stay in both the groups.

Method of statistical analysis

Data was entered Microsoft excel data sheet and was analyzed using SPSS 22 version software. Categorical data was represented in the form of Frequencies and proportions. Chi-square test was used as test of significance for qualitative data. Continuous data was represented as mean and SD. Independent t test was used as test of significance to identify the mean difference between two quantitative variables.

Graphical representation of data: MS Excel and MS word were used to obtain various types of graphs such as bar diagram. p value (Probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests. Statistical software: MS Excel, SPSS version 22 (IBM SPSS Statistics, Somers NY, USA) was used to analyze data.

Sample size

Sample size was estimated based on the difference in proportion of uneventful recovery in group A and group B. By using the formula

Sample size= r +1/r(p*) (1-p*) (Zβ + Zα/2)2/ (p1 –p2)2

r =ratio of control to cases, 1 for equal number of case and control

p* = average proportion exposed = proportion of exposed cases + proportion of control exposed/2

Zβ = Standard normal variate for power = for 80% power it is 0.84 and for 90% value is 1.28. Researcher has to select power for the study.

Zα/2 = Standard normal variate for level of significance as mentioned in previous section.

p1 –p2 = effect size or different in proportion expected based on previous studies. p1 is proportion in cases and p2 is proportion in control from the study by Khan S p1 =

87.5%, p2 = 70.37% at 80% confidence level and 80% power, with equal ratio in two groups. N = 64 in each group.[8] Considering non-response rate of 10%, 64 + 6 = 70 patients in each group will be selected.

Inclusion criteria

Patients with peritonitis secondary to hollow viscus perforation. Patients with age >18years and <70years.

Exclusion criteria

- Peritonitis secondary to trauma to the abdomen.
- Peritonitis secondary to gynaecological interventions like DandC.
- Peritonitis secondary to malignancies and immuno-compromised state
- Patients allergic to Ceftriaxone, Metronidazole and Amikacin.
- Tertiary peritonitis.

RESULTS

A total of 140 patients who presented with peritonitis secondary to hollow viscus perforation, admitted and treated in RL Jalappa Hospital and Research Centre attached to Sri Devaraj Urs Medical College, Kolar were studied during the period of December 2015 to June 2017.

Gender distribution comparison between two groups

In present study of 140 patients with peritonitis secondary to hollow viscus perforation, the total number of males were 112(80%) in both the groups (Group A and B). The number of male patients were 55 and 57 accounting for 78.6% and 81.4% in group A and B respectively.

Table 1: Gender distribution comparison between two groups.

Count			Group A	Count	Group B
Gender	Female	15	21.4%	13	18.6%
	Male	55	78.6%	57	81.4%

The total number of females were 28(20%) in both the groups (Group A and B). The number of female patients were 15 and 13 accounting for 21.4% and 18.6% in group A and B respectively. There were 6 deaths in the study. These patients had severe form of peritonitis and presented late to the hospital. Males showed higher incidence of hollow viscus perforation in comparison with females.

Incidence of perforation in different age groups

Patients of the age >18years and <70years were included in the study and the youngest patient in this study is a 19-year-old boy who had appendicular perforation and the

oldest patient in this study is an old man of 69years who was diagnosed and treated for duodenal perforation. The mean age of perforation in group A is 38.7 years and the mean age in group B is 37.2 years. More than half of the patients fall between the age group of 21-40, out of which 33 patients were in the age group of 21-30 and 39 patients in the age group of 31-40.

Table 2: Age distribution comparison between two groups.

<20 years	Count	Group A	Count	Group B
21 to 30 years	8	11.4%	5	7.1%
	12	17.1%	21	30.0%
31 to 40 years	21	30.0%	18	25.7%
41 to 50 years	19	27.1%	16	22.9%
51 to 60 years	4	5.7%	7	10.0%
>60 years	6	8.6%	3	4.3%
Mean Age		38.7±13.3		37.2±13

This shows that more than half of the perforations are seen in young adults.

Relation between age and the site of perforation

In this study, there were 12 cases of duodenal perforation, 5 cases of pre-pyloric perforation, 14 cases of appendicular perforation and 7 cases of ileal perforations in the age group of 19 to 29 years.

There were 25 cases of duodenal perforation, 07 cases of pre-pyloric perforation, 7 cases of appendicular perforation and 4 cases of ileal perforations in the age group of 30 to 39 years.

There were 20 cases of duodenal perforation, 06 cases of pre-pyloric perforation, 04 cases of appendicular perforation, 1 case of ileal perforation and 1 case of jejunal perforation in the age group of 40 to 49 years.

There were 9 cases of duodenal perforation, 2 cases of pre-pyloric perforation, 2 cases of appendicular perforation and 2 cases of ileal perforation in the age group of 50 to 59 years.

There were 7 cases of duodenal perforation, 2 cases of pre-pyloric perforation, 1 case of appendicular perforation and 1 case of ileal perforation in the age group of 60 to 69 years.

More than half of the perforations(n=80) are in the age group of 19 to 39 age group accounting for 57% of the cases. Proximally located perforation like duodenal and pre-pyloric perforations are common in the younger age group.

Table 3: Comparison of mean duration of hospital stay between two groups.

Duration of Hospital stays (Days)			
		Mean	SD
Group	Group A	16.3	6.2
	Group B	12.6	4.6
P value		<0.001*	

Comparison of Post-operative complications in both the groups with regards to the postoperative complications (local and systemic),19 cases were detected in both the groups (Group A and B).

In Group A, 4 patients developed chest infections accounting for 5.7%, 2 patients developed intra-abdominal abscess accounting for 2.9% and the abscess was drained under ultrasound guidance and pig tail catheter was inserted for both patients and the pus was sent for culture and sensitivity and the report was showing the growth of E.coli in 1 patient and Klebsiella in other patient and the organisms were sensitive to ceftriaxone, ciprofloxacin and imipenem and appropriate antibiotic was started and the patients recovered and the catheter was removed when the output has ceased, one patient had developed paralytic ileus who accounted for 1.4%, 3 patients developed fecal fistula who accounted for 2.3% were treated conservatively and successfully, spontaneous closure of fistula was noted but the patients had a very long duration of hospital stay.5 patients developed surgical site infections (SSI) like wound gaping, stitch abscess accounting for 7.1%.

In Group B, 2 patients developed chest infections accounting for 2.9% and 2 patients developed surgical site infections (SSI) like wound gaping, stitch abscess accounting for 2.9%. There were no complications like intra-abdominal abscess, paralytic ileus and fecal fistula in group B patients. Overall, 15 patients who received 2 antimicrobials (Ceftriaxone and Metronidazole) in Group A and 4 patients who received 3 antimicrobials (Ceftriaxone, Metronidazole and Amikacin) had developed post post-operative like chest infections, intraabdominal abscess, paralytic ileus, fecal fistula and surgical site infections. Hence the usage of three drug regimen is more beneficial in treating perforative peritonitis.

Relation between the site of perforation and the type of organism isolated

In this study, 71 patients had duodenal perforation at the time of laparotomy and the most common organism isolated in these patients was *E. coli* which was grown in 20 patients followed by *Enterobacter* and *Klebsiella*.

21 patients had pre-pyloric perforation and the most common organism in these patients was *E. coli* which was cultured in 14 patients followed by *Enterococcus*.

29 patients had shown appendicular perforation at the time of surgery and 10 patients had shown the growth of *E.coli* followed by Klebsiella.

16 patients had ileal perforation at the time of laparotomy and the most common organism isolated was E. coli which was seen in 8 patients followed by Enterococcus.

1 patient with jejunal perforation had shown the growth of Enterobacter. 25 patients with duodenal ulcer perforation, 15 patients with pre-pyloric perforation and 5 patients with appendicular perforation had shown negative culture of peritoneal fluid.

More the distal is the site of perforation in gastrointestinal tract (GIT), more is the degree of peritoneal contamination and bacterial growth. More the proximal is the site of perforation, less is the degree of peritoneal contamination and bacterial growth provided the patient presents earlier to the hospital.

The patients with lesser degree of peritoneal contamination may be treated with two antimicrobial regimens, but three drug regimens is beneficial in most of the cases because of broad spectrum of activity and also in preventing the post operativehospital stay and complications.

Number of days of hospital stay

Duration of hospital stay extended from 5 to 30 days. The maximum number of days of hospital stay is between 06 - 15 days where 52 patients stayed between 6 – 10 days followed by 11 – 15 days which accounted for 39 patients. The mean stay in hospital was 16.3 days for patients who received 2 antimicrobials (Ceftriaxone and Metronidazole) where as it was 12.6 days for patients who received 3 antimicrobials (Ceftriaxone, Metronidazle and Amikacin). The maximum number of days apatient stayed in the hospital is for 29 days who was operated for duodenal perforation and minimal duration of stay of a patient is for 5 days who underwent surgery for appendicular perforation. In present study we found that patients who received 3 antimicrobials (Ceftriaxone, Metronidazole and Amikacin) had shorter stay in the hospital.

Comparison of p – values with use of two and three antimicrobials

Overall the number of patients who had developed post-operative complications who received three drugs were 4 compared to 15 patients who developed postoperative complications when they received two drugs. Consequently, the mean duration of hospital stay was 12.6 in patients who received three drugs when compared to 16.3 in the patients who received two drugs. Reduction in the number of days of hospital stay and less post-operative complications were noted in the patients who received 3 antimicrobials (Ceftriaxone, Metronidazole

and Amikacin) (group A) when compared to 2 antimicrobials (Ceftriaxone and Metronidazole) (group B). p – value was significant in patients belonging to group B i.e p=0.007(<0.05) when compared to p – value in group patients i.e. p=0.06(>0.05).

DISCUSSION

A total of 140 patients who presented with features of peritonitis secondary to hollow viscus perforation to R. L. Jalappa Hospital and Research Centre, Tamaka, Kolar, from December 2015 to June 2017 were randomized into two groups and studied.

In Group A, patients with all odd serial numbers were included and received 2 antimicrobials (Ceftriaxone and Metronidazole) and in Group B patients with all even serial numbers were taken and received 3 antimicrobials (Ceftriaxone, Metronidazole and Amikacin). This clinical study was intended to determine the efficacy of two antimicrobials (Ceftriaxone and Metronidazole) and three antimicrobials (Ceftriaxone, Metronidazole and Amikacin) in perforative peritonitis and to compare the clinical outcome of perforative peritonitis with two and three antimicrobials in the terms of reduction in postoperative infections and hospital stay.

In general, this study revealed that the maximum number of patients were in the age group of 21-40 with the mean age of 37 years and the youngest patient in this study is a 19-year-old boy who had appendicular perforation and the oldest patient in this study is an old man of 69 years who was diagnosed and treated for duodenal perforation. More than half of the patients fall between the age group of 21-40 years, out of which 33 patients were in the age group of 21-30 and 39 patients in the age group of 31-40. This shows that more than half of the perforations are seen in young adults. Male population was affected more than female population because of the irregular eating or dietary habits, smoking and alcoholism and duodenal ulcer perforation is the commonest followed by appendicular, pre-pyloric, ileal and the rest.

The randomized study involved 140 patients of both sexes with perforative peritonitis. Age of the patients in this study ranged from 19years to 69 years. The mean age of the patients at the time of admission was 37 years. Maximum number of patients 72 (51.4%) were in the age group of 21-40 years, Samir Delibegovic et al and Ashis Ahuja et al stated predominant population from age group 21-40 years. C Ohmann et al study showed predominant population in 50-69 years age group. These findings are similar from present study.

Age group with highest incidence of post-operative complications highest incidence of post-operative complications in present study was in the age group of 61-69 years. CO hmann et al cited highest mortality in age >70yrs. Notash et al also stated complications are more in >60 years of age. In present study it was

observed that incidence of post-operative complications increases with increase in age.[8,9]

Sex distribution

Current study showed the male preponderance in peritonitis with ratio of male: female as 4:1. Male preponderance was also found in Samir Delibegovicet al with male to female ratio of 3:1, Ajazahamed Malik et al with 2:1 and also in Sharma R, Huttunen et al.[10-12] Current study showed the Gastroduodenal perforations (73.2%) are commoner in peritonitis followed by small intestinal (27.2%). The observation done in present study is comparable to other studies done in various centres.

More than half of the perforations(n=80) are in the age group of 19 to 39 age group accounting for 57% of the cases. Proximally located perforation like duodenal and pre-pyloric perforations are common in the younger age group. This study shows the more delay in the presentation to the health care centre, the more is the degree of peritoneal contamination. Majority of the patients who had presented earlier to the hospital i.e., within 12 hours had shown serous type of exudates. The patients who had late presentation to the hospital had shown contaminated foul-smelling type of peritoneal fluid (purulent/ feculent collection).

19 patients had post-operative complications ranging from wound gaping, stitch abscess, pneumonia, intra-abdominal abscess, paralytic ileus to fecal fistula. 3 patients had fecal fistulas which were treated conservatively and successfully.

More the distal is the site of perforation in gastrointestinal tract (GIT), more is the degree of peritoneal contamination and bacterial growth.

More the proximal is the site of perforation, less is the degree of peritoneal contamination and bacterial growth provided the patient presents earlier to the hospital.

The patients with lesser degree of peritoneal contamination may be treated with two antimicrobial regimens, but three drug regimens are beneficial in most of the cases because of broad spectrum of activity and also in preventing the post-operative hospital stay and complications.

The organisms grown were *E. coli, Enterococci, Acinetobacter, Enterobacter and Klebsiella*. However, E. coli was the major and the most common organism grown accounting for growth in 48 of the patients. Antibiotics should be used prophylactically before contamination has occurred. This is not possible in patients where the infection is already established. In these situations, the use of antimicrobial drugs to prevent the growth of bacteria which occurs due to disease/trauma is therapeutic rather than prophylactic.[13]

Combination antibiotic therapy has been used to provide the patient with broad-spectrum coverage against the many potential pathogens encountered in abdominal trauma. Several potential benefits of the clinical use of antibiotic combinations have been advanced.[14] These include expansion of spectrum of either agent alone allowing treatment of polymicrobial infections and prevention of emergence of antibiotic resistant organism, reducing the potential for toxicity with aminoglycosides and other agents with demonstrated in vitro synergistic activity or additive affect; more effective treatment of bacteraemia in neutropenic patient.[15]

We have used two antimicrobials (ceftriaxone and metronidazole) in group A and three antimicrobials (Ceftriaxone, Metronidazole and Amikacin) in group patients. Ceftriaxone is known to be a bactericidal agent against most of aerobic and few anaerobic organisms. Metronidazole is active against most of anaerobic organisms. Amikacin is effective against gram negative organisms and few gram-positive organisms like Staphylococcus aureus. In present study treatment with 3 antimicrobials (Ceftriaxone, Metronidazole and Amikacin) in perforative peritonitis is statistically significant in reduction in the postoperative hospital stay and complication in comparison with 2 antimicrobials (Ceftriaxone and Metronidazole).

E. coli was the most common organism isolated in both the groups followed by *Enterococci, Klebsiella* and the rest.

In present study there were 6 deaths which were due to severity of illness due to delay in seeking medical treatment; all of them were seen by us on 4th – 5th day of onset of severe abdominal pain. The complications due to unhindered pathological process and irreversible damage might have been responsible for death in this patient. This is in contrast to the observation by Atkins and Colleagues16 who attributed mortality in these series to gross and diffuse peritoneal soiling.

The incidence of post-operative complications in this study is less in patients who received treatment with 3 antimicrobials (Ceftriaxone, Metronidazole and Amikacin) and it is statistically significant when compared to treatment with 2 antimicrobials (Ceftriaxone and Metronidazole).

The incidence of hospital stay was less in the patients who received treatment with 3 antimicrobials (Ceftriaxone, Metronidazole and Amikacin) and it is statistically significant when compared to treatment with 2 antimicrobials (Ceftriaxone and Metronidazole).

CONCLUSION

The clinical and bacteriological study has demonstrated the following:

- Peritonitis is more common in men compared to women.
- The common age group is in between 21 -40 years in cases of peritonitis with the mean age of 37 years.
- Duodenal ulcer perforation is the commonest site of perforation.
- E. coli is the commonest organism isolated from the peritoneal contamination.
- Bacterial /peritoneal contamination increases with time.
- Delayed presentation i.e., more than 12-24 hours increases the degree of contamination.
- Postoperative complications like surgical site infections, pneumonia intra-abdominal abscess are more in the patients with distally situated perforation and who had delayed presentation to the health care centre.
- So, patients who are elderly, who had delayed presentation to the hospital and distally situated perforation with severe degree of contamination, it is a safe option to consider three antimicrobials for the treatment.
- 3 antimicrobial usage significantly (<0.05) reduces the post-operative complications like surgical site infections, pneumonia intra-abdominal abscess when compared to 2 antimicrobial usage.
- As per the clinical outcome is concerned, there is a significant difference in the both the groups, treatment with 3 antimicrobials is better than 2 antimicrobials.

REFERENCES

1. Ashish A, Ravinder P. Prognostic scoring indicator in evaluation of clinical outcome in intestinal perforations. J Clin Diagn Res. 2013;7:1953-55.
2. Avinchey DJ, Collum PT, Lynch G. Towards a rational approach to the treatment of peritonitis: an experimental study. Br J Surg. 1984;71:715-17.
3. Macro C, Patric G. Life-threatening upper GI emergencies, Part-2: Upper GI bleeding and perforation: brief article. Int J Crit Illn Inj Sci. 200;16:367-73.
4. Hoffman J. Peritoneal lavage as an aid in the diagnosis of acute peritonitis of non-traumatic origin. Dig Dis. 1988;6:185-93.
5. O'Brein P, Tait N, Bushell M. Management of diffuse peritonitis by prolonged post-operative peritoneal lavage under systemic antibiotic coverage ANZ J Surg. 2008;57:181-84.
6. Ajaz AM, Khurshid AW, Latif AD, Mehmood AW, Rauf AW, Fazl QP. Prediction of outcome in patients with peritonitis depending on the severity at the time of presentation. Turk J Trauma Emerg Surg. 2010;16:27-32.
7. Mazuski JE, Sawyer RG, Nathens AB. The Surgical Infection Society guidelines on antimicrobial therapy for intra-abdominal infections: evidence for the recommendations. Surg Infect. 2002;3:175-233.
8. Ohmann C, Wittmann DH, Wacha H. Prospective evaluation of prognostic scoring systems in peritonitis. Peritonitis Study Group. Eur J Surg. 1993;159(5):267-74.
9. Notash, Ali YN, Javad S, Hosein R, Mojagan SHF, Ali A. Evaluation of Mannheim peritonitis index and multiple organ failure score in patients with peritonitis. Indian J Gastroenterol. 2005;24:197-200.
10. Delibegovic S, Markovic D, Hodzic S, Nuhanovic A. Evaluation of Prognostic Scoring Systems in the Prediction of the Outcome in Critically Ill Patients with Perforative Peritonitis. Acta Inform Med. 2010;18(4):191-5.
11. Ajaz AM, Khurshid AW, Latif AD, Mehmood AW, Rauf AW, Fazl QP. Mannheim Peritonitis Index and APACHE II - Prediction of outcome in patients with peritonitis. Turk J Trauma Emerg Surg. 2010;16:27-32.
12. Sharma L, Gupta S, Soin AS, Sikora S, Kapoor V. Generalized peritonitis in India-the tropical spectrum. Jpn J Surg.1991;21:272-7.
13. Rajender SJ, Ashok KA, Robin K, Rajeev S, Anupam J. Spectrum of perforation peritonitis in India-review of 504 consecutive cases. World J Emerg Surg. 2006,1:26.
14. Nitin A, Sudipta S, Anurag S, Sunil C, Anita D, Sanket G. Peritonitis: 10 years' experience in a single surgical unit. Tropical Gastroenterology. 2007;28:117-20.
15. Sawyer MD, Dunn DL. Antimicrobial therapy of intra-abdominal sepsis. Surg Infect. 1992;6:546.
16. Hunt RC, Atkins C, Scott DF, Holds Worth SR, Davidson AJ. Prolonged antibiotic peritoneal lavage combined with systemic antibiotics in the management of gross generalized peritonitis. Med J Aust. 1976;19:954-6.