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A PROSPECTIVE STUDY ON THE VALUE OF PROPHYLACTIC ANTIBIOTICS PRIOR TO COLONOSCOPY IN PATIENTS ON AUTOMATED PERITONEAL DIALYSIS

Nephrology

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ABSTRACT

Objective: To evaluate the need for prophylactic antibiotics in automated peritoneal dialysis (APD) patients undergoing flexible colonoscopy.

Patients and Methods: A total of 100 patients on automated peritoneal dialysis (APD) undergoing diagnostic colonoscopy were enrolled in a prospective randomized study. Patients were randomized into two age and sex matched groups; group A (50 patients) with intraperitoneal (IP) ceftazidime prior to colonoscopy and group B (50 patients) without prophylactic antibiotics. Relation between peritonitis and different parameters were analyzed.

Results: Of all colonoscopies 61% showed normal findings, 15% with colonic polyps at different sites, 12% with angiodysplastic-like lesions, 6% with colonic ulcer (s), 4% with diverticulae without diverticulitis and 2% had transverse colon stricture. Post-colonoscopy peritonitis was documented in 4 (4%) and 5 (5%) patients in groups A and B respectively (p =0.4046); the causative organisms were mainly gram-negative bacteria. polypectomy was not associated with increased peritonitis episodes. By multiple logistic regression analysis, diabetes mellitus was the only independent variable that entered into the best predictive equation over the development of post-colonoscopy peritonitis but not antibiotic use.

Conclusion: The relation between prophylactic antibiotic use prior to colonoscopy in APD patients and the risk of peritonitis was lacking. Only diabetes mellitus and age above 60 years appears to be of significance. Polypectomy did not increase peritonitis episodes.

KEYWORDS

APD, ESRD, diabetes, colonoscopy, peritonitis, antibiotic prophylaxis.

Introduction

In peritoneal dialysis (PD) patients, the colon is felt to be a potential source of dialysate contamination, especially in patients who have diverticulitis (1). The incidence of colonoscopic-induced bacteremia is variable, reported from 0% to 27% of patients (2, 3). It has been recommended that antibiotic prophylaxis be given to immunocompromised patients and those with known valvular heart disease or prostheses prior to colonoscopy (4, 5). Few cases, however, have been reported in the literature on peritonitis following colonoscopy in continuous ambulatory peritoneal dialysis (CAPD) patients (6-10). These reports suggested that diagnostic instrumental procedures such as colonoscopy may precipitate gram-negative peritonitis in those patients. The enforcement of the aseptic precautions and the improvement in PD techniques has led to a reduction in peritonitis rates (11). The few case reports in the literature on peritonitis following colonoscopy were all in CAPD but not on automated PD (APD) patients (6, 7, 12-15). In the 2007 series reported by Yip et al (11), 3 of 5 peritonitis episodes were culture negative. The authors could not explain the cause of such a high percentage of culture negative results. The organisms causing these 3 episodes of peritonitis might not have originated from the gastrointestinal tract. In the same series, the risk of developing CAPD peritonitis after colonoscopy in patients without antibiotic prophylaxis was statistically not significant. The 2016 International Society for Peritoneal Dialysis (16) Guidelines showed evidence 2-C favoring the use of prophylaxis antibiotics prior to the procedure (16). However, there has been little literature to support this recommendation. The objective of the present study was to investigate the risks and outcomes of peritonitis after flexible colonoscopy and to show whether there is a need for prophylactic antibiotics in automated peritoneal dialysis (APD) patients undergoing this procedure.

Patients and Methods

A prospective randomized study of patients with ESRD on APD and undergoing colonoscopy was performed according to The Declaration of Helsinki at King Fahd University Hospital, Al-Khobar, Saudi

Arabia. The study was conducted from March 2014 throughout April 2017 with prior approval by King Fahd Hospital Human Ethical committee. All patients were above 18 years of age and written informed consents were obtained from every patient after full explanation of the aim of the study, the complications of colonoscopy and the expected outcomes. Pregnant females, patients with ongoing sepsis, valvular or chronic heart disease, urinary tract infections, chronic liver disease, exit-site or tunnel infections, pneumonia or pulmonary tuberculosis, peritonitis or history of peritonitis for the last one year were excluded from the study (Figure-1). One hundred patients (71 males, 29 females) were included in this study. Patients were randomized (1:1) into two groups; Group A: 50 patients on APD with IP prophylactic antibiotic therapy before the flexible colonoscopy, Group B: 50 patients on APD without prophylactic antibiotics (Table-1). All flexible colonoscopic examinations were performed by trained gastroenterology consultants. All Staff in the endoscopy unit were aware of the potential hazard of cross-infection and assiduous mechanical cleaning followed by disinfection was done. The following parameters: age, gender, duration on dialysis, diabetic state, use of antibiotics before the procedure, and indications for and findings of colonoscopy were studied. APD peritonitis episodes occurring within 72 hours after colonoscopy, culture results and outcomes of peritonitis were recorded. At our center, the colonoscopy bowel preparation protocol included a low residue diet 2 days before the examination and patients are instructed to take a fluid diet the day before the procedure. Oral electrolyte lavage solutions or aqueous sodium phosphate solution were used as laxative for bowel preparation. Peritoneal dialysis effluent (PDE) was drained and the patient's abdomen was kept empty before the procedure. Ceftazidime, in a dose of 1 gm was given intraperitoneally as a prophylaxis against peritonitis 1 hour before colonoscopy and kept for at least 7 hours post procedure. Peritonitis was diagnosed when abdominal pain and cloudy fluid occurred with or without fever, and when peritoneal fluid white blood cell (WBC) count was >100/mm3, with >50% neutrophils. Episodes with peritoneal eosinophilia but negative bacterial culture were excluded. The PDE was sent for hematological and microbiological examination when patients complained of abdominal pain or if the PDE was turbid. For the microbiological tests, 50 mL peritoneal fluid was centrifuged at 5000g for 15 minutes. The deposit was inoculated on 5% sheep blood agar, MacConkey agar, and Sabouraud agar and incubated aerobically at 35°C for up to 72 hours. All isolates were identified by standard biochemical methods and the identity of the isolates was confirmed using the Vitek Automicrobic System (bioMerieux, Vitek, Hazelwood, Missouri, USA). Antimicrobial susceptibility was tested by the Kirby–Bauer disk diffusion method and results interpreted according to the National Committee for Clinical Laboratory Standards Criteria (17).

APD procedure

All Patients were on automated peritoneal dialysis (APD) and their dialytic prescription consisted of 1.36% and 2.27% glucose-based solutions Dianeal® over 9-10 hours night dwell and 7.5% icodextrin (Extraneal®, Baxter Castlebar, Ireland) 2 liters as the last fill for the day dwell if needed. Total daily PD volume ranged between 10-12 liters with a fill volume ranging between 2.0-2.5 liters/cycle.

Colonoscopy procedure

In the procedure room, all patients were given supplemental oxygen (4 L/min) through a nasal cannula, and a 3-lead electrocardiogram, pulse oximetry, and blood pressure were monitored. A trained anesthesiologist attempted to achieve a level of sedation that allowed the patient to tolerate the procedure with minimal to mild pain while maintaining adequate cardiorespiratory function. Propofol induction of sedation was begun with an initial 20-40-mg followed by titration with 10–20-mg boluses. Fentanyl was administered intravenously in 12.5- or 25-g boluses and midazolam as 0.5–1.0-mg boluses. Additional medication was titrated at 1–3-minute intervals to achieve or maintain the desired level of sedation. The following time points were recorded: initiation of sedation, full sedation, colonoscope insertion, intubation of the cecum, and colonoscope removal from the anus. Interventional procedures like polypectomy were performed when indicated with disposable polypectomy snare G-Flex. Post polypectomy bleeding (if any) was managed by epinephrine injection, hemoclip and heat probe.

Biopsies were taken when indicated by disposable biopsy forceps (Endow by Olympus).

Any complications (decline in oxygen saturation to less than 85%, heart rate less than 50 beats per minute, blood pressure less than 90/50 mm Hg, or need for mechanical ventilation) were recorded.

Peritonitis therapy

Peritonitis episodes were treated in our center according to the ISPD peritonitis guidelines (18). Antibiotic regimens for individual patients were modified when culture results became available. Treatment usually lasted for either 2 weeks or at least 7 more days after normalization of the effluent WBC count, whichever was longer. The indications for catheter removal included peritonitis caused by Pseudomonas species, peritonitis caused by fungal infection, peritonitis associated with tunnel infection with the same organism, and episodes with suspected bowel perforation.

Statistical methods

Continuous variables are expressed as mean + SD and categorical variables are expressed as percentage. Student's t-test or Mann-Whitney test was used to compare the means of continuous variables. Chi-square test was used to compare the percentages of discrete variables. Multiple logistic regression analyses were used to establish the best determinants over the development of at least one episode of peritonitis of enteral origin (dependent variable). The predictive variables included in the model were: age, gender, diabetic versus nondiabetic, intestinal abnormalities, time on APD, hemoglobin and albumin levels and prophylactic antibiotic use. P values were not adjusted for multiple testing and therefore should be considered descriptive. The statistical analyses were limited to data regarding only the first episode of peritonitis, unless otherwise noted. Statistical significance was accepted at $p < 0.05$. The statistical analysis was performed using SPSS for Windows version 20 (IBM Inc. New York, USA).

Results

A total of 100 colonoscopies were performed in 100 APD patients during the 3-year study. Mean age was 56.6 ± 9.8 years and duration of dialysis was 31.1 ± 6.6 months; 42 (42%) patients were diabetics. The 100 APD patients included in the study were randomized into two groups; group-A (50 patients) who received IP ceftazidime prophylaxis prior to colonoscopy and group-B (50 patients) who had colonoscopy without antibiotic prophylaxis. Randomization was 1:1. Demographic characteristics of patients are summarized in table-1. The two groups were age and sex matching. Diabetes mellitus was present in 40% and 44% and hypertension in 86% and 82% in the two groups respectively (p=0.3076 & 0.3035). Mean duration of diabetes mellitus and the duration on APD was 19.3 + 9.7 years and 18.8 + 9.9 years, 31.3 + 10.6 months and 30.8 + 11.7 months in groups A and B respectively (p = 0.3833 & 0.3761). The difference in overall fasting blood sugar (FBS) and hemoglobin A1-C (Hgb A1-C) was not statistically significant between the two groups. At the time of colonoscopy, the mean blood urea nitrogen (BUN), serum creatinine and renal creatinine clearance were 46.13 + 8.55 mg/dl and 48.12 + 5.27 mg/dl; 7.46 + 2.51 mg/dl and 7.13 + 2.87 mg/dl; 8.2 + 2.4 and 7.8 + 2.7 ml/min in groups A and B respectively with no statistical significance (table-1). Mean hemoglobin level, serum potassium (K+) and serum albumin were similar in both groups at the time of the procedure (table-1). Indications for and findings of colonoscopy are summarized in table-2 and figure-2. Of all colonoscopies 61% showed normal findings, 15% with colonic polyps at different sites, 12% with angiodysplastic-like lesions, 6% with colonic ulcer (s), 4% with diverticulae without diverticulitis and 2% had transverse colon stricture. Inflammatory bowel disease in the five patients was inactive for more than one year. Findings at colonoscopy are shown in figure-2. All Post-colonoscopy peritonitis occurred within 48 hours following the procedure. It was documented in 4 (8%) and 5 (10%) patients in groups A and B respectively (p =0.3041); the causative organisms were mainly gram-negative bacteria (5 out of 9 cases were gram negative bacteria, one with gram positive organisms, two negative culture and one with Candida albicans) (table-3). Peritonitis episodes were not documented in any patient with diverticulosis or biopsied colonic polyps. All peritonitis cases resolved with treatment and one patient from group A and 1 from group B required catheter removal because of fungal peritonitis in the former and refractory peritonitis in the later. Complications other than peritonitis were 0.0% in both groups. Different variables were analyzed to demonstrate its relation with peritonitis episodes (Table-4). No significant difference in serum BUN or serum creatinine was observed between those who developed peritonitis and those who did not in the two groups. By multiple

logistic regression analysis, the presence of diabetes mellitus was the only independent variable that entered into the best predictive equation over the development of enteric peritonitis (log likelihood ratio = -25.072, odds ratio = 17; 95% CI odds ratio: 2 - 151).

Discussion

Peritonitis in PD patients after colonoscopy is a known but infrequent complication. A retrospective study from Hong Kong revealed an average risk of peritonitis after colonoscopy of 6.3% in 77 CAPD patients after 97 endoscopic procedures. Colonic biopsy or other interventions such as polypectomies apparently did not increase the risk of peritonitis (19-21). The source of contamination in those cases not associated with catheter exit-site or tunnel infections is thought to be transmural (1, 19). Micro-organisms may gain access to the peritoneum from the intestinal lumen or through genital organs (22, 23). Diagnostic instrumental procedures, such as colonoscopy, have been implicated in the development of these peritonitis episodes (14, 15). Post colonoscopy peritonitis in patients undergoing PD is thought to result from translocation of microorganisms across the bowel wall (24) and it has been alleged that gastrointestinal endoscopic procedures in those patients can lead to peritonitis (25). However, in many cases there is no evidence that links peritonitis to colonoscopy as a risk factor (21, 22). The recommendations concerned with colonoscopy in PD patients are not based on randomized controlled trials because such studies in PD patients are limited. Where there is no definitive evidence but the group feels there is sufficient experience to suggest a certain approach, this is indicated as "opinion" based. The recommendations are not meant to be implemented in every situation but are recommendations only. Each center should examine its own pattern of infection, causative organisms, and sensitivities and adapt the protocols as necessary for local conditions (20). Contrary to Yip et al (11) who, in a selected cohort, suggested that diverticulosis may be a risk factor for the development of enteric peritonitis, we did not encounter such complication in our patients. Moreover, colonic diverticulosis did not appear to affect the outcome of colonoscopy in our study. Supporting our findings was the report by Toda et al. (26) who studied 317 PD-candidate patients over approximately 4 years and concluded that asymptomatic diverticulosis identified by computed tomography was not a risk factor for enteric peritonitis in their study population. In addition, colon biopsy or polypectomy did not appear to further increase the risk of peritonitis in our cohort. A retrospective study by Yip et al. (27) found that the risk of peritonitis after colonoscopy without antibiotic prophylaxis was 6.3%. The authors however, indicated that it lacks statistical significance. Interestingly, the International Society for Peritoneal Dialysis recommended antibiotic prophylaxis before any procedure involving the abdomen or pelvis, including colonoscopy (16). Again, it is important to notice that these recommendations were based only on observational studies and case reports. The 2005 and the 2016 ISPD guidelines suggested empirical 1 gram ampicillin or aminoglycoside with or without metronidazole before colonoscopy (16, 28). These guidelines recommend antibiotic prophylaxis for CAPD patients undergoing colonoscopy with polypectomy; however, there has been little literature to support these recommendations. Studies on these guidelines are rare, and randomized controlled trials to support this recommendation are lacking. Moreover, these new guidelines clearly stated that the optimal antibiotic regimen has not been determined by clinical studies yet (16). Contrary to the suggestions above, the American Society for Gastrointestinal Endoscopy and the British Society of Gastroenterology do not suggest prophylactic antibiotics before colonoscopy (29, 30). There exists a lack of consensus on this issue. There have been few case reports in the literature on peritonitis following colonoscopy in peritoneal dialysis patients (6, 7, 14-16). These reports suggested that instrumental procedures such as colonoscopy may precipitate gram-negative peritonitis in PD patients. On the other hand, some literature reported bacterial peritonitis following endoscopic polypectomy in peritoneal dialysis patients despite antibiotics prophylaxis (10). So far there are no strong data demonstrating a causal association between endoscopic procedures and bacteremia or that antibiotic prophylaxis prior to endoscopic procedures protects against bacteremia. Much of the existing data reflects estimated risk associated with conventional endoscopic techniques. There are no results available that confidently quantify bacteremia rates with newer endoscopic procedures such as per oral endoscopic myotomy, endoscopic submucosal dissection, flexible colonoscopy or polypectomy (11). Use of a single IP antibiotic prophylaxis was encouraged by many authors based on pharmacokinetic (PK) evidences. In the study of the PK of IP cefazolin and ceftazidime, Elwell, et al. (31) reported serum cefazolin and ceftazidime levels that exceeded the minimum inhibitory concentrations for susceptible organisms (8 mg/L) throughout the 20 hour study period. Predictive equations suggested that 1000 mg IP of cefazolin or ceftazidime every 24 hours would produce average steady-state trough serum cefazolin and ceftazidime concentrations of 70 +/- 52 mg/L and 17 +/- 7 mg/L, respectively. In another study, Tobudic, et al. (32) reported that the maximum serum concentrations after intravenous and IP administration of other antibiotics were comparable. Ratios of IP to systemic exposure indicated good systemic exposure after intraperitoneal application but limited penetration of the antibiotic into the peritoneal fluid after the intravenous dose. Similar results were reported by Weisholzer, et al. (33) and Low, et al. (34). In 2006, A well designed prospective study of PK of cefepime by Elwell, et al. suggested that most APD and CAPD patients would achieve adequate serum cefepime concentrations if infused with a standard dose of 1000 mg given IP (35). It is becoming an accepted policy to use IP instead of IV antibiotics in PD patients when needed, as IP applications of antibiotics achieves a higher target-site concentrations, less gastrointestinal side effects and improved compliance (18, 36). We studied APD patients with and without IP antibiotic prophylaxis before flexible colonoscopy. The difference in peritonitis episodes in our study between the two groups was not statistically significant (8.0% vs. 10.0%, $p > 0.05$). Interestingly, transient bacteremia occurs frequently during routine daily activity, often at rates exceeding those associated with endoscopic procedures. Brushing and flossing of teeth has been associated with rates of bacteremia of 20% to 68%, use of toothpicks with rates of 20% to 40%, and even activity that might be considered entirely physiologic, such as chewing food, with rates ranging from 7% to 51% (37). By multiple logistic regression analysis, the use of prophylactic antibiotics prior to colonoscopy was not a predictive variable for developing post-colonoscopy peritonitis in our study population. One patient from those who received prophylactic antibiotics had Candida species in peritoneal fluid culture. Although we could not prove the relation between antibiotic prophylaxis and the development of this un-expected growth, it is not unreasonable to speculate that antibiotic administration may have favored intestinal non-bacterial overgrowth (Candida in our case) and use of more than one antibiotic may make it even worse. Given the notorious possibility of resistant strains' development and the relative rarity with which most PD patients undergo colonoscopy procedures, the frequency and risk of colonoscopy-related bacteremia, as we demonstrated in our study, is trivial compared with the frequency of bacteremia encountered with routine daily activity. This may provide a reasonable basis against routine administration of antibiotic prophylaxis prior to all endoscopic procedures. There are, however, some limitations in our study. First, this study was conducted in a single tertiary medical center, and endoscopy-associated complications may vary in different hospitals. Second, the study was conducted on a selected group of APD patients after applying strict exclusion criteria. Third, the study used a single antibiotic and may have underestimated the importance of combined antibiotic prophylaxis. Therefore, larger randomized trials are required to explore the necessity of antibiotic prophylaxis in the prevention of postcoloscopic PD peritonitis. Nevertheless, our study has the strength of being the first prospective randomized study in this field.

Conclusion

The relation between peritonitis and prophylactic antibiotic use prior to colonoscopy in APD patients was lacking. Only diabetes mellitus appeared to be of significance. Neither polypectomy; partial or complete nor diverticulosis were associated with increased incidence of post-colonoscopy peritonitis. The study, however, recorded limited number of patients and may have underestimated the importance of combined antibiotic prophylaxis. Therefore, larger prospective randomized trials are needed.

DISCLOSURES

The authors have no financial conflicts of interest to declare.

Table 1: Demographic characteristics of the study population

	Group A (n = 50)	Group B (n = 50)	p
Age (years), mean + SD	51 + 8.7	52 + 5.1	0.2818
Female/Male (female %)	19/31 (38.0)	20/30 (40.0)	0.3210

Smokers (%)	26.0	22	0.1767
Hypertension, n (%)	43 (86.0)	41 (82.0)	0.2315
BMI at beginning, mean + SD	28.4 + 3.7	29.1 + 2.8	0.3102
Diabetes mellitus, n (%)	20 (40.0)	22 (44.0)	0.2861
Duration of diabetes, (years), mean + SD	19.3 + 9.7	18.8 + 9.9	0.2451
Duration on APD, months (mean + SD)	31.3 + 10.6	30.8 + 11.7	0.3887
Overall FBS in diabetics, mmol/L (mean + SD)	8.44 + 1.3	8.21 + 1.7	0.3420
Overall Hgb A1C % in diabetics (mean + SD)	7.0% + 0.6	6.8 + 0.8	0.2753
Hgb at colonoscopy, gm/dl (mean + SD)	10.23 ± 2.25	10.14 + 2.74	0.4033
BUN at colonoscopy, mg/dl (mean + SD)	46.13 + 8.55	48.12 + 5.27	0.2784
Serum Cr. at colonoscopy, mg/dl (mean + SD)	7.46 + 2.51	7.13 + 2.87	0.4051
Serum K+ (mEq/L)	3.9 + 1.7	3.9 + 2.1	0.5021
Serum albumin (gm/l)	3.9 + 1.8	3.8 + 1.7	0.4224
Renal Cr Cl. ml/m (mean + SD)	8.2 + 2.4	7.8 + 2.7	0.3078

BMI: Body mass index, APD: automated peritoneal dialysis, FBS: Fasting blood sugar, Hgb: hemoglobin, BUN: blood urea nitrogen, Cr: creatinine, K+: potassium, Cr Cl: creatinine clearance.

Table 2: Indications for and findings of colonoscopy

Number (%)	Indication	Findings (number)	Action (number)
17(17.0)	Screening for colonic Cancer	Normal (14) Transverse and descending colon polyps (3)	None (14) Biopsies and removal (3)
16 (16.0)	Investigation for iron deficiency anemia	Normal (13) Angiodysplastic like lesions (3)	None (13) Biopsies & bleeding protocol (3)
16 (13.3)	Altered bowel habits (chronic diarrhea or chronic constipation)	Normal (10) Diverticulae (4) Transverse colon polyps (2)	None (10) None (4) Biopsies and removal (2)
12 (12.0)	Positive fecal occult blood testing without overt rectal bleeding	Normal (5) Angiodysplastic-like lesions (5) Descending colon polyp (2)	None (5) Biopsies & bleeding protocol (5) Biopsies and removal (2)
11 (11.0)	Overt rectal bleeding	Normal (3) Transverse or descending colon ulcers (3) Angiodysplastic-like lesions (3) Ascending & transverse colon polyp (2)	None (3) Biopsies & bleeding protocol (3) Biopsies & bleeding protocol (3) Biopsies and removal (2)
8 (8.0)	Finding of polyp (s) during sigmoidoscopy	Normal (4) Descending colon polyps (3) Angiodysplastic-like lesions (1)	None (4) Biopsies and removal (3) Biopsies & bleeding protocol (1)
8 (8.0)	Bloody effluent	Normal (7) Transverse colon polyp (1)	None (7) Biopsies and removal (1)
8 (8.0)	Family history of colon cancer or polyps	Normal (5) Ascending colon polyp (2) Descending colon ulcer (1)	None (5) Biopsies and removal (2) Biopsies (1)
4 (4.0)	Inflammatory bowel disease	Transverse and/or descending colon ulcers (2) Transverse colon stricture (2)	Biopsies (2) Stent (2)

Table 3: Microorganisms responsible for peritonitis

Patient's No#	Group A (4 cases) Microorganisms	Outcome	Patient's No#	Group B (5 cases) Microorganisms	Outcome
12	E. coli + Enterobacter	Treated	5	E. coli	Treated
28	Candida albicans	PD catheter removed	22	Klebsiella species	Treated
36	Klebsiella	Treated	29	Culture negative	Treated
42	S. aureus	Treated	41	Enterobacter	Treated
			48	Culture negative	Treated

Table 4: Comparison of characteristics of patients with and without peritonitis after colonoscopy

	Group 1 Peritonitis No peritonitis	p	Group 2 Peritonitis No peritonitis	p
Number (%)	4 (8.0) 46 (92.0)		5 (10.0) 45 (90.0)	
Age (year)	52.0 + 7.2 51.2 + 7.1	0.3331	52.1 + 5.4 52.3 + 6.1	0.4121
Diabetes, n (%)	4/4 (100) 16/50 (32.0)	0.0325	5/5 (100) 15/50 (30.0)	0.0341
Duration on APD, month, (mean)	31.1 + 10.2 31.7 + 10.6	0.3102	29.9 + 12.2 30.1 + 8.3	0.3720
BUN, mg/dl (mean)	46.1 + 9.1 45.7 + 10.4	0.4013	48.0 +5.3 47.8 + 9.2	0.3213
Creatinine, mg/dl (mean)	7.32 + 2.5 7.48 + 2.3	0.3106	7.11 + 2.7 7.24 + 2.9	0.4004
Hemoglobin, gm/dl (mean)	10.28 + 2.0 9.87 + 2.8	0.2841	10.0 + 2.51 10.31 + 1.82	0.4101
Serum K+, mEq/l (mean)	3.8 + 2.1 3.7 + 1.7	0.4002	3.9 + 1.1 3.8 + 2.6	0.4202
Serum albumin, gm/dl (mean)	3.8 + 2.2 4.0 + 1.2	0.2816	3.9 + 1.3 3.8 + 2.3	0.3235

APD: automated peritoneal dialysis, BUN: blood urea nitrogen, K+: potassium

Legend of Figure-1: Consort diagram demonstrating study design and patients' progress. HD: chronic or valvular heart disease, UTI: urinary tract infection, ESI: exit-site infection, TI: tunnel infection, CLD: chronic liver disease, peritonitis: ongoing or previous.

Legend of Figure-2: Finding of colonoscopies in the study population.

ADL: Angiodysplastic-like lesions.

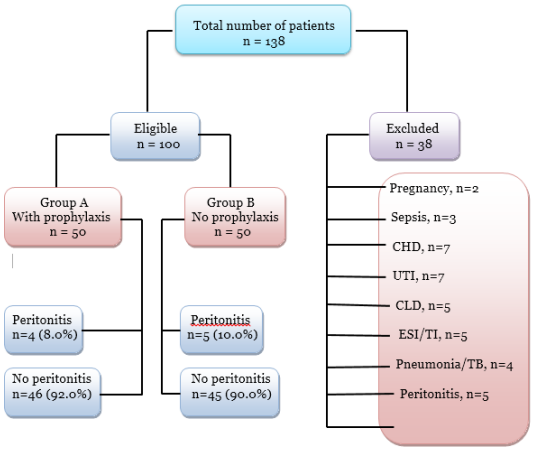

Figure-1: Consort diagram demonstrating study design and patients' progress.

CHD: chronic or valvular heart disease, UTI: urinary tract infection, CLD: chronic liver disease, peritonitis: ongoing or previous.

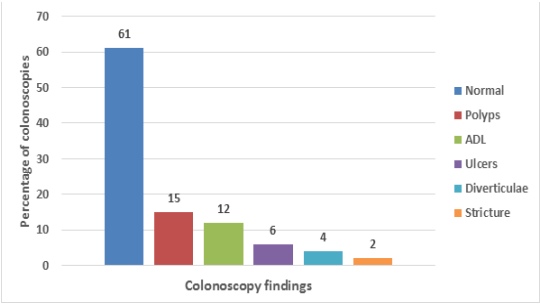

Figure-2: Finding of colonoscopies in the study population.

ADL: Angiodysplastic-like lesions

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