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Outcomes in Patients with End-Stage Renal Disease and Colonic Diverticular Disease

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Outcomes in Patients with End-Stage Renal Disease and Colonic Diverticular Disease

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ABSTRACT

Purpose: To evaluate clinical presentation and outcomes of patients with end-stage renal disease (ESRD) or renal transplantation and symptomatic colonic diverticular disease

Methods: A retrospective review of all patients with the primary diagnosis of diverticulitis or diverticulosis and end-stage renal disease treated at Yale-New Haven Hospital from January 1, 1985 to December 31, 2005 was performed. Patient factors evaluated including age, gender, comorbidities, nature of ESRD, and immunosuppression if any, along with the diagnosis of diverticulosis or diverticulitis, complicated vs. uncomplicated and outcomes including morbidity, mortality and LOS. Patients were evaluated to determine predictors of poor outcome. Simple summary statistics were calculated. Chi-square analyses were used to compare categorical and binary data. ANOVA was used for continuous outcome variables including length of stay.

Results: Mean age was 70+/-13 years. Thirty/77(39%) were male. Thirty-three/54(61%) presented with gastrointestinal hemorrhage. Twenty-three/33(70%) required transfusion. One/28(4%) required surgery; one/28(4%) required angiographic embolization. There were no deaths. Twenty-five/77(30%) developed symptomatic diverticulitis. Seventeen/25(68%) were uncomplicated. Fifteen/17(88%) were managed conservatively; 1/17(6%) required surgery. Eight/25(32%) presented with complicated diverticulitis; three/8(38%) with perforation and 2/8(25%) with abscess. Eight/8 (100%) with complicated disease required urgent/emergent surgery. Five/8 (55%) who underwent surgery developed a perioperative complication. Four/8 (50%) died following surgery.

Risk-factors for death were female peritoneal dialysis, surgery, diabetes, and perforation ($p<0.05$). Overall mean LOS for diverticular disease was 14.5+/-26 days.

Conclusions: The presentation of diverticular disease in ESRD patients differs from those with normal renal function. ESRD patients have higher rates of diverticular bleeding requiring transfusion. Patients with ESRD who develop diverticulitis frequently present with complicated disease, requiring surgery. Those that require surgery for diverticulitis have a high mortality. Those with uncomplicated disease can be successfully managed conservatively. ESRD may adversely effect treatment of symptomatic diverticular disease.

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INTRODUCTION

Overview of diverticulosis and diverticulitis

A colonic diverticulum is defined as a sac-like protrusion of the bowel wall. Diverticulosis describes the presence of diverticula, and diverticulitis indicates inflammation of those diverticula. The term diverticular disease encompasses both diverticulosis and diverticulitis. Diverticular disease increases with age and is reported to be as high as 65 percent in autopsy studies. Of those with diverticulosis, it is estimated that 10-25 percent will develop clinically significant peridiverticular inflammation, and 5-15 percent will develop symptomatic bleed requiring hospitalization [1]. In severe cases, diverticulitis may be complicated by abscess, obstruction, free perforation, obstruction, or sepsis. Treatment is restricted to medical therapy and dietary change in uncomplicated cases. Surgical intervention may be required to halt intractable bleeding, drain an abscess, relieve an obstruction, resect perforated bowel, or to address peritonitis after perforation.

Epidemiology

Diverticulosis and diverticulitis were very uncommon at the start of the twentieth century and were reported only incidentally in the medical literature. Surgical intervention for diverticular disease was not reported until 1907, when William Mayo performed the first colon resection for complicated diverticulitis [2]. Diverticular disease has become more common over the past century. Prevalence was increased from 5 to 10 percent in the 1930s [3] to 35 to 50 percent in 1969 [4]. No recent population-based

studies have been published. Prevalence of diverticular disease increases with age. It has been reported to be less than 5 percent at age 40, 30 percent at age 60, and 65 percent at age 85 [3, 5].

Recent studies show equal male-female distribution or perhaps slight female preponderance, in contrast to earlier studies [5]. This may be explained by a gender distribution that changes with age. In the 50 year-old and under age group, there is a higher prevalence in men than in women. The distribution shifts slightly towards women in the 50 to 70 year-old age group, and then shifts markedly towards females in the over 70 year-old group [6,7].

Geography is also a significant factor in the prevalence of diverticulosis. This is most likely due to differences in diet and lifestyle. In Western countries, prevalence rates across all age groups are reported at 5 to 45 percent [4, 8]. On the other hand, prevalence in Africa and Asia is reported at less than .2 percent, a marked difference [3, 9]. There diverticula are primarily right-sided, as opposed to Westernized nations, where disease is found primarily in the left colon. Consistent with the Western lifestyle leading to right- more than left-sided diverticulitis, Japan has been experienced a rapid increase in right-sided diverticulitis in recent years, concurrent with its adoption of a more Western lifestyle. In one study of 615 Japanese patients, right-sided diverticula were discovered in 70 percent of individuals [10]. Similarly, a larger study in which 15,000 Japanese subjects were examined radiographically over a 15-year period showed an increase in right-sided diverticulosis over time, while the frequency of left-sided diverticula remained constant [11].

Pathophysiology

Diverticula develop in areas of weakness in the bowel wall, allowing the vasa recta to penetrate through the wall. Pathologically, patients with colonic diverticula are found to have myochosis, which consists of circular muscle layer thickening, shortening of the taeniae, and luminal narrowing. Structural changes in collagen are also observed. These changes resemble those that result from aging but are greater in magnitude.

Weakness in the connective tissue of the colon decreases the resistance of the bowel wall to intraluminal pressure. LaPlace's law helps to explain the development of diverticula. This law states that intraluminal pressure is directly proportional to wall tension and inversely proportional to bowel radius. Hence, pressure will be highest where radius is smallest; the sigmoid colon has the smallest average radius, but under normal circumstances this should not matter, as the colon is one continuous unit of volume with equal pressure throughout. However, in diverticular disease, colonic motility becomes impaired, leading to a phenomenon known as exaggerated segmentation. Segmentation is process where muscular contraction separates the colon into chambers, increasing pressure over small regions. It is unclear on a cellular level why diverticulosis impairs motility, but the resultant increased pressure increases the possibility of mucosal herniation [12]. The theory behind a high-fiber diet preventing diverticular disease is that it increases stool bulk and hence bowel radius, decreasing pressure.

Diverticulitis is thought to result from erosion of the diverticular wall when it is subjected to increased intraluminal pressure or inspissated food particles. Inflammation and focal necrosis result, ultimately allowing perforation to occur. Mild inflammation

will lead to clinically insignificant perforation. More substantial perforations lead to abscess and/or peritonitis. Diverticular bleed occurs when a vessel becomes stuck over the dome of a developing diverticulum; it is separated from the bowel lumen by mucosa only. As time progresses, the vasa recta is subjected to injury along its luminal side. This drives thickening of the intima and thinning of the media. Ultimately, segmental weakness of the artery is present and it may rupture into the bowel lumen [13].

Diagnosis

Diverticulosis is usually an incidental finding on routine sigmoidoscopy or colonoscopy. Patients with diverticulosis sometimes report minor gastrointestinal complaints, including constipation, diarrhea, bloating, and flatulence.

Acute diverticulitis can usually be a clinical diagnosis. However, radiographic and endoscopic studies are also often performed, typically including a CT scan in the acute setting (to rule out other sources of abdominal pain and serious complications of diverticulitis) and an elective colonoscopy after the episode has resolved (to assess the degree of diverticular disease throughout the colon).

CT scan is currently regarded as the best radiographic test for suspected acute diverticulitis. A study of 150 patients presenting to the emergency room with clinical signs of diverticulitis showed that helical CT with oral contrast has a sensitivity of 97 percent and a specificity of 100 percent [14]. The most common CT finding in patients with diverticulitis is increased soft tissue density in the pericolic fat (98 percent). Other common findings include colonic diverticula (84 percent) and thickening of the bowel wall (70 percent) [15, 16, 17]. Perhaps more importantly, CT identifies the main

complications of acute diverticulitis, including obstruction, abscess, peritonitis, and fistula formation. Additionally, in the case abscess, CT-guided drainage may be attempted in lieu of surgery [18].

Presentation

In Western countries, the most common presenting symptom in patients with diverticulitis is left lower quadrant pain, seen in 70 percent of presentations, consistent with the preponderance of left- over right-sided disease. Duration of pain is usually on the order of days rather than hours, helping to differentiate it clinically from other causes of acute abdominal pain. One study reports that only 17 percent of patients with abdominal pain and radiographically documented diverticulitis have experienced less than one day of pain [19]. Additional common symptoms include constipation (50 percent), nausea and vomiting (20 to 62 percent), diarrhea (25 to 35 percent), and urinary changes (10 to 15 percent) [20].

On physical examination, localized tenderness is a frequent finding, most commonly restricted to the left lower quadrant. Abdominal distention also may be observed. A lower quadrant mass may be palpated is less common. Generalized tenderness may be present but is suggestive of complicated disease [21]. A low grade fever may be present in uncomplicated disease. Changes in vital signs consistent with sepsis and shock may be exist in complicated disease, including fever, hypotension, tachycardia, and tachypnea. Routine laboratory tests reveal leukocytosis in as few as around 50 percent of cases; hence, a normal white count cannot be used as a basis for

excluding diverticulitis [22]. Liver function tests and pancreatic enzymes are typically within normal limits.

Medical therapy

Treatment of uncomplicated diverticulitis is centered on dietary modification and antibiotic administration. In cases where the patient is stable enough for discharge, an antibiotic regimen with activity against gram negative rods and anaerobes should be selected. One common approach is metronidazole plus either a quinolone or trimethoprim-sulfamethoxazole. Amoxacillin-clavulanate can also be used. Patients are treated for a week to 10 days. In terms of diet, patients should consume only clear fluids for two to three days and advance their diet only when showing signs of clinical improvement. In order to reduce the probability of recurrence, a high fiber diet is recommended; although to date there are no randomized controlled studies to support this recommendation [23, 24]. At least two controlled studies on fiber supplementation in patients with known diverticulitis have been performed, but their results are not consistent and further research remains necessary [25, 26].

Patients who have uncomplicated disease but who are not stable enough to return home are typically treated with IV antibiotics and are kept NPO with intravenous hydration. There is no evidence whatsoever to suggest that patients with diverticular disease need avoid seed-containing foods. The thought that seeds may become lodged in diverticula and encourage inflammation is completely unproven.

Surgical therapy

There are several indications for surgery. Traditionally, patients with two episodes of diverticulitis, even if uncomplicated, have been advised to have an elective resection. The goal is to prevent morbidity and mortality from a future complicated presentation. The risk/benefit must be considered for each individual patient, taking into account age and comorbidities [27]. With the more frequent application of laparoscopic colectomy, more patients may be able to undergo "prophylactic" colon resections. Several studies suggest that the laparoscopic approach shortens recovery time. To date, laparoscopic surgery for diverticulitis has been shown to be best applied in the elective setting (i.e., six weeks after a resolved case of diverticulitis) or with less severe complicated acute cases (abscess but no peritonitis) [28].

In the acute setting, the severity of complicated diverticulitis is divided into four stages, known as Hinchey's classification. Stage one entails a pericolic or mesenteric abscess; stage two represents a walled-off pelvic abscess; stages three and four represent generalized purulent and fecal peritonitis, respectively [29]. The two main approaches currently employed are single-stage repair (primary anastamosis) and two-stage (temporary colostomy) repair. The single-stage approach is restricted to elective or semielective cases. Urgent and emergent situations require the two-stage technique. These cases usually involve macroscopic perforation and contamination of the peritoneal cavity. There are two ways to divert incoming bowel contents to the colostomy. In Hartmann's procedure, the affected colon is resected, leaving an end-colostomy and a rectal stump. The alternative approach is to resect the diseased colon, perform a primary

anastamosis, and create a proximal diverting stoma. Hartmann's procedure is usually the technique of choice in diverticulitis-related peritonitis cases.

Diverticular disease in patients with renal failure

Up to 80 percent of hemodialysis patients report symptoms of gastrointestinal distress [30]. Upper gastrointestinal disease occurs with some frequency, including disease of the stomach, gallbladder, and pancreas. Lower gastrointestinal diseases of importance are ischemic bowel disease, kayexalate-induced colonic necrosis, spontaneous perforation of the colon, fecal impaction, diverticular disease, and angiodysplasia. Most lower gastrointestinal conditions are thought to be secondary to renal medications or dialysis-induced hypotension. Overall, most features of the disease – presentation, diagnosis, and treatment – are similar in patients with or without renal dysfunction.

The literature began documenting an association between diverticulitis and ESRD or renal transplantation about 30 years ago. Early studies in the 1970s and 1980s of patients with ESRD or renal transplantation documented an increased frequency of – and the high mortality rate associated with – diverticulitis in this particular group of patients [31]. These patients seem more likely to do poorly than patients without renal disease when they suffer a perforation, with mortality reaching as high as 75 percent. Moreover, patients with diverticular disease and ESRD or renal transplant have also been shown to have higher rates of complicated disease and more often require surgery for their episodes [38]. Relatively few papers have been written on this topic, so we will examine each in some detail.

In 1978, Carson et al. reviewed approximately 800 cases of renal transplantation and found that 13 patients had suffered colonic perforation, 6 of whom from diverticulitis [31]. All but one died in the perioperative period. The paper argued that those patients were at particularly high risk and that high mortality rates could be reduced by early operation to reduce the contamination in the peritoneal cavity. The authors conclude, "The lethality of colon perforation after transplantation in our opinion does warrant elective colon resection prior to transplantation if there is a history of previously symptomatic diverticulosis coli." No statistics were performed on the data due to the very limited number of complicated diverticulitis cases. In a similar paper published even earlier, Sawyer et al. go so far as to recommend that since the mortality from complication of colorectal diseases in immunosuppressed patients is so high, particularly in patients with diverticulosis, consideration should be given to exclusion from transplantation or elective segmental colectomy prior to transplantation [39].

In a 1985 study, Starnes et. al. published a retrospective review of 25 patients who suffered from ESRD and were operated on for colonic diverticular disease [32]. Of the 25 subjects, 12 were status-post renal transplantation and 13 were undergoing hemodialysis. Overall mortality was 28%, with 6 of the 7 deaths occurring in patients who had free colonic perforations at surgery. The vast majority of operations involved a diverting colostomy. Mortality was found to correlate with age, with 43 percent of patients over 50 dying after surgery, versus 9 percent under the age of 50. Sepsis was the most common cause of death. Dialysis patients suffered post-operative complications more frequently (100 percent) than transplant patients (58 percent). Several factors were noted to explain diverticular disease in renal patients, including constipation (increasing

intraluminal pressure), autonomic dysfunction, and reduced tissue strength and wound healing. Of note, no correlation was found between survival rate and type of surgery performed, dose of immunosuppression administered, or type of treatment used for ESRD. An obvious limitation of this study was that it lacked sufficient patient enrolment to achieve statistical significance in any area.

In 1988, Lao et al. looked at 325 patients who had received a kidney transplant [33]. Overall, 8.6 percent of patients had a colonic complication of some sort in the five years they were followed after transplantation. Four patients were found to have clinically significant diverticular disease: one suffered from a diverticular hemorrhage, while three experienced complicated diverticulitis (two perforations and one colovesicular fistula). All three diverticulitis cases went to the operating room, and one of the perforations resulted in death. It was noted that renal transplant patients suffer a variety of gastrointestinal complications, particularly in the month after transplantation, including pseudomembranous colitis and colonic ischemia.

Lederman's retrospective review in 1998 of 1,137 kidney transplant recipients revealed a low rate of complicated diverticulitis in this group (1.1 percent) [34]. All complicated cases required surgery but perioperative mortality remained low (7.7 percent). Patients with polycystic kidney disease exhibited a higher rate of complicated diverticulitis (5.6 percent versus .85 percent, $p<.0001$). Traditionally, steroid-based immunosuppression has been known to predispose patients to perforation and to mask presenting symptoms of complicated disease, leading to poorer outcomes [35]. The authors compared cyclosporine versus steroid immunosuppression, and while the cyclosporine group had fewer cases of complicated diverticulitis, significance was not

achieved. Donor kidney source had no statistically significant effect on rate of diverticular complications.

In 2000, Lederman et al. looked retrospectively at the rate of diverticulitis and diverticular complications in patients with polycystic kidney disease (PKD) [36]. They further argue that a high index of suspicion is important because in this patient population symptoms and signs of this disease may be masked by corticosteroid or immunosuppressive therapy. In transplant patients, diverticultis is the most common cause of colonic perforation and often presents with asymptomatic pneumoperitoneum. This cohort included 184 total patients with renal failure from several causes, 59 of whom had PKD. Patients with PKD were found to experience a significantly higher rate of diverticulitis (20 percent) than do other patients with end-stage renal disease (3 percent). In addition, they found that diverticulitis is more severe in PKD patients, with 50 percent needing surgical intervention. The authors conclude that PKD patients with ESRD may benefit from colonic screening given their high rate of diverticulitis and diverticulitis-related complications even compared to other patients with ESRD. They speculate that these poor outcomes may be somehow related to a connective tissue defect in the colon that may be caused by the same gene mutation that leads to PKD. Several investigators have looked at PKD and diverticulitis, and this data was pooled (Tab. 1).

Table 1. Past studies on renal transplantation, PKD, and diverticulitis

Author	No. Patients	Diverticulitis	Diverticulitis and PKD
Hognestad and Flatmark (1976)	226	5	3
Sawyerr et. al (1978)	113	4	1
Guice et al. (1979)	392	7	2
Nghiem and Corry (1983)	525	4	2
Starnes et al. (1985)	863	11	3
Church et al. (1986)	824	7	2
McCune et al. (1991)	1,019	4	1
Lederman et al. (1998)	1,137	13	6
Total	5,099	55 (1.1%)	20 (36%)

A larger study in 2005 by Della Valle et al. looked at 875 renal transplant recipients with functioning allografts [37]. From that group, 8 patients (.9 percent) suffered a colon perforation secondary to complicated diverticulitis. Mean interval between transplantation and perforation was 4.1 years. The surgical mortality rate was 12.5 percent. This mortality was substantially lower than that reported in several previous studies, which ranged from 25 to 66 percent, and the authors attribute it to aggressive surgical management, although what this means is poorly defined in the study. The authors state, “In conclusion, acute diverticulitis with colon perforation in kidney transplantation remains a serious complication, even if incidence and mortality have decreased over the last years. Success in management is strictly related to an aggressive diagnostic attitude and immediate surgical treatment.”

Having reviewed the literature to date, there have been no studies examining the clinical characteristics of patients with ESRD who develop diverticular disease and few studies have evaluated treatment protocols or outcomes in these patients. This study looks to examine the experience at one institution over the last 20 years and to characterize the clinical presentation and outcomes in patients with ESRD or renal

transplantation and symptomatic colonic diverticular disease. Because of the complexity of disease in these patients, their compromised cellular immunity, as well as other comorbidities, initial management of diverticular disease in these patients has the potential to affect long term outcomes and cost.

STATEMENT OF PURPOSE AND HYPOTHESIS

We hypothesize that patients with ESRD and diverticular disease present with complicated disease at a higher rate than those with normal renal function, and that they have worse outcomes upon hospitalization.

METHODS

This study is a retrospective review of all patients with a primary diagnosis of diverticulitis or diverticulosis and end-stage renal disease or history of transplantation treated at Yale-New Haven Hospital from January 1, 1985 to December 31, 2005. Outcomes for patients with ESRD with or without transplantation and an admitting diagnosis of diverticular disease were included in the review. Excluded from our analysis were patients with acute renal failure, renal insufficiency but not true ESRD that required dialysis or transplant, or those who had an incidental diagnosis of diverticular disease.

Charts of 101 patients admitted to our institution with both ESRD and symptomatic colonic diverticular disease were identified. Of these, 77 patients were found to have accurate diagnosis codes and their charts were reviewed. Standard demographic and clinicopathologic data were collected on all patients and entered into an

electronic database. The following information was extracted for analysis: age, gender, length-of-stay, presenting symptoms, CT diagnosis of diverticulitis or diverticulosis, complicated or uncomplicated course, colonoscopy results, etiology of ESRD, transplant history, vital signs, admission lab values, transfusion history, antibiotic treatment, smoking history, surgical outcomes including complications and mortality, type of surgical resection, immunosuppression use, steroid use, and several common comorbidities. The Human Investigation Committee at Yale-New Haven Hospital approved this study. The main outcome measures evaluated were length of stay (LOS), complications, and in-hospital mortality.

Simple summary statistics were completed. Chi-square analyses were used to compare categorical and binary data. Analysis of variance was used to compare continuous data. Patients were evaluated to determine predictors of poor outcome.

RESULTS

101 patients were identified with both ESRD and colonic diverticular disease as a primary diagnosis for their admission. Of these patients, 77 patients had clinically significant diverticular disease as the primary reason for their admission, confirmed by either colonoscopy or CT scan. Mean age of patients was 70 +/-13 years. Thirty-nine percent (30/77) were male. Most patients had at least one prior episode of documented diverticular disease (N=45, 58.4%). All patients had documented evidence of colonic diverticular disease. Patients with diverticulitis were not significantly different than those with bleeding diverticulosis based on clinical characteristics. Patient comorbidities were also evaluated (Tab. 2).

Table 2. Sample Characteristics

Age(μ±std)	70.31 +/- 13.2
Gender(n/%)	
Female	47 (61)
Smoking History(n/%)	
Yes	37 (48.1)
Current Smoker(n/%)	12 (15.6)
Yes	
Prior Attacks(n/%)	
None	19 (24.7)
1	45 (58.4)
2	3 (3.9)
3 or more	5 (6.5)
Comorbidities(n/%)	
DM	27 (35.1)
HTN	19 (24.7)
CAD	37 (48.2)
COPD	8 (10.4)
PVD	17 (22.1)

Table 3. Demographics By Diagnosis

	Diverticulitis (N=25)	Bleeding Diverticulosis (N=33)	p-value
Age(μ±std)	67.39+/-15.5	71.25+/-13	----
Gender(n/%)			
Female	18 (72)	17(51.5)	NS
Smoking History(n/%)			NS
Yes	11 (50)	16 (50)	
Current Smoker(n/%)			NS
Yes	5 (22.7)	6 (18.8)	
Prior Attacks(n/%)			NS
None	7 (28)	8 (24.2)	
1	15 (60)	16 (48.5)	
2	1 (4)	2 (6.1)	
3 or more	2 (8)	2 (6.1)	
Comorbidities(n/%)			
DM	11 (44)	15 (45.5)	NS
HTN	7 (33.3)	9 (29)	
CAD	11 (47.8)	14 (43.8)	
COPD	2 (8.7)	5 (15.6)	
PVD	3 (12)	8 (24.2)	
Chronic Steroid Use			NS
Yes	5 (20)	6 (18.2)	

Table 4. Clinical Presentation

	Diverticulitis (n/%)	Bleeding Diverticulosis (n/%)	p-value
Diverticulitis			
Complicated	8 (32)	n/a	---
Transfused			
Yes	8 (32)	23 (72)	<0.05
CT Obtained?			
Yes	22(88)	7(21.2)	<0.0001
CT Findings			
Diverticulitis	20 (91)	0 (0)	<0.01
Perforation	4 (18)	0 (0)	
Abscess	1 (4)	0 (0)	
Colonoscopy Obtained	4(16)	29(87.9)	<0.0001
Yes			
Colonoscopy Findings			
Diverticulosis	3(75)	29(88)	<0.0001

Table 5. Treatment/Outcomes

	Diverticulitis	Bleeding Diverticulosis	p-value
LOS (µ±std)	15.6+/-32	7.8+/-5.8	----
Surgery (n/%) Yes	7 (29)	1(3)	<0.05
Percutaneous Drain (n/%) Yes	1 (4)	0 (0)	NS
Operative Complications (n/%) Yes	5 (71)	0 (0)	NS
Mortality (n/%) Yes	4 (16)	0 (0)	NS

Forty-three percent (N=33) of patients presented with gastrointestinal haemorrhage. Of these 29 (88%) received a colonoscopy either therapeutically or diagnostically. None of these patients received a CT scan as part of their initial evaluation.

Thirty-two (N=25) percent of patients presented with symptomatic diverticulitis. Sixty-eight percent of those were complicated. Eight (32%) patients required transfusion. The majority of these patients had a CT on admission (22/25, 88%) (Tab. 4).

Of patients with GI hemorrhage, seventy percent (N=23) of those required transfusion. Three percent (N=1) required surgery and three percent (N=1) required angiographic embolization for uncontrollable bleeding. There were no in-hospital deaths for patients with bleeding diverticulosis.

For patients with diverticulitis (N=25), 71 percent of cases (N=18) were managed conservatively and twenty-nine percent (N=7) required surgery. Eighty-eight percent of the patients with complicated disease underwent urgent or emergent surgery.

Of all patients with diverticular disease and ESRD or transplant, nine patients (eight with diverticulits, and one with bleeding diverticulosis) required surgery. Seventy-

one percent of patients who underwent surgery had a perioperative complication. Four patients died, all were patients who underwent surgery for diverticulitis, had diabetes, and had a history of peritoneal dialysis (Tab. 6).

Table 6. Mortality

	In - Hospital Deaths (n=4)	p-value
Age(μ±std)	68+/-10	-----
Comorbidities (n/%)		
DM	4 (100)	<0.05
CAD	2 (50)	NS
COPD	0 (0)	NS
PVD	2 (50)	NS
Surgery(n/%)	4 (100)	<0.0005
Gender(n/%)		
Female	3 (75)	NS
Smoking History(n/%) Yes	3 (75)	NS
Peritoneal Dialysis(n/%) Yes	4 (100)	0.016
Chronic Steroid Use(n/%) Yes	1 (24)	NS

Table 7. Cases requiring surgery

Diagnosis	Patients (N)	Female (N/%)	Mortality (N/%)	Urgency (N/%)
Bleeding Diverticulosis	1	0 (0)	0 (0)	Urgent 1 (100)
Diverticulitis	8	7(87)	4(50)	Urgent 2 (25) Emergent 5 (62.5) Elective 1 (12.5)

DISCUSSION

While the association of ESRD or renal transplantation and diverticulosis has been documented in the past, this is the first study to evaluate both clinical and patient characteristics and outcomes.

Overall, patients with ESRD or renal transplantation who develop diverticular disease are not significantly different from one another in their demographic characteristics. Those with bleeding diverticulosis often require transfusion and colonoscopy for either treatment or diagnosis.

When patients with diverticulitis present with uncomplicated disease they can be successfully managed conservatively. However, when they have complicated diverticulitis, they do appear to have poor clinical outcomes, requiring surgery and often having post-operative complications. These patients also have a high mortality even following surgery.

Because of the complexity of disease in these patients, their compromised cellular immunity, as well as other comorbidities, initial management of diverticular disease in these patients has the potential to affect long term outcomes and cost. These patients should be treated with caution.

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