The Evaluation of The Presence of Colonic Diverticulum in Patients with Abdominal Aortic Aneurysm

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Abstract

Aim: The evaluation of the relationship between the aortic aneurysm and colonic diverticulum in the tomography images of the patients followed-up for abdominal aortic aneurysm

Methods: The tomographic images of 97 patients (Female/Male:20/77) aged between 40-88 years with/without abdominal aortic aneurysm and colonic diverticulum were analyzed. Abdominal aortic diameters were analyzed by categorizing them as 20-29 mm, 30-49 mm, and 50 mm over, and the presence of colonic diverticulum in the abdominal aorta with these diameters. The presence of plaque, narrowing, and dilatation in ascending, descending, and abdominal parts of the aorta was evaluated, and the levels of arterial plaque, narrowing, and stenosis in the inferior and superior mesenteric arteries supplying the intestine were assessed.

Results: The rate of colonic diverticulum was found to be significantly lower in the tomographic images of the patients with normal abdominal aortic diameter. It was found that the frequency of colonic diverticulum increased as the abdominal aortic diameter increased from 29 mm to 50 mm and above.

Conclusion: The probability of detection of colonic diverticulum increases as the diameter of the abdominal aorta increases.

Keywords: *Abdominal aortic aneurysm, colonic diverticulum, tomography*

1. Introduction

An abdominal aortic aneurysm (AAA) is a disease characterized by progressive enlargement of the abdominal aorta. The aneurysm may be initially asymptomatic. Subsequently, various gastrointestinal complaints may develop. Endoscopic examination performed to clarify these complaints may reveal the presence of colonic diverticulum due to hypoperfusion that takes place in the etiology of the aneurysm. Aneurysm pathophysiology is degeneration in the aortic wall, weakening of the connective tissue, loss of elasticity, and consequently, dilatation secondary to inflammation. There is a relationship between atherosclerosis and aneurysm development[1]. The development of aneurysm involves vascular wall weakening due to wall degeneration and aortic wall enlargement due to dilatation[2]. Atherosclerosis and secondary degeneration develop in the majority of aneurysms as age advances. The pathological aging process presents intimal thickening, lipid deposition, calcification, and eccentric fibrosis. That leads to the weakening of the vascular wall and dilatation. Abdominal aortic aneurysm usually begins infrarenally beneath the diaphragm and continues until the bifurcation of common iliac arteries[3].

Diverticulum is characterized by an outpouching of the gastric or intestinal wall[4]. Diverticula are the mucosal outpouchings acquired due to gastrointestinal peristaltic contractions and high intraluminal pressures. The mucosal and submucosal layers of the gastrointestinal system wall are protruded. Colon is the most common location of the diverticula in the gastrointestinal system[5]. The second most common location is the duodenum[6]. Diverticular disease may be symptomatic with complications such as acute diverticulitis or diverticular hemorrhage, or it may develop asymptomatically. Acute colonic diverticulitis is seen in approximately 10-25% of the patients[7]. Diverticula may be coincidentally detected and diagnosed, or encountered by endoscopy performed for colonic diverticula. Tomography is not a routine procedure in the diagnosis of a diverticulum. However,

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tomography must be performed in the presence of acute diverticulitis[7]. In contrast, tomography is routinely performed for follow-up of aortic aneurysm. Colonic diverticulum and abdominal aortic aneurysms are initially asymptomatic, and both are frequently seen in the 5th and 6th decades. The relationship between aortic aneurysm and diverticulum has been shown in the literature[8]. However, no study reported comorbidity of abdominal aortic aneurysm and colonic diverticulum was found in the literature. The presence of colonic diverticulum in patients presenting with the clinical picture of abdominal aortic aneurysm and diagnosed by tomography contributes significantly to the diagnosis and treatment of the disease. Aortic wall weakness, endothelial malnutrition, and the mechanism alteration caused by inflammation and hypoperfusion may predispose to the development of diverticulum due to alterations in the vascular structures that supply the stomach.

We encountered the presence of colonic diverticulum in the tomographic images of most patients followed-up for abdominal aortic aneurysm. We hypothesized that aortic wall weakening, endothelial malnutrition, the alteration mechanism due to inflammation, and hypoperfusion, as etiological factors for aortic aneurysm, may predispose to the development of diverticulum due to alterations in the vascular structures that provide colonic perfusion. Hence, we analyzed the tomographic images of the patients with aneurysm concerning the colonic diverticulum.

2. Materials and methods

Our study analyzed 97 patients admitted with clinical picture of aortic aneurysm to the Department of Cardiovascular Surgery between 2019-2021. Those were the patients with aortic aneurysm aged between 40-88 years that were recently diagnosed or followed up. We analyzed the abdominal tomographic images of the patients with aneurysm concerning the colonic diverticulum (Table 1). We assessed the severity of aortic narrowing and stenosis as well as the severity of plaque, narrowing, and stenosis (Table 2) in the superior and inferior mesenteric artery (SMA and IMA) branches of the abdominal aorta that supply the intestine.

Twenty of the patients included in our study were those were initially admitted to the General Surgery Clinic with a diagnosis of diverticulitis and were evaluated for aorta by tomography.

2.6. Statistical Analysis

We analyzed study data using SPSS Version 21 software package. We applied the t-test and Chi-Square test for the variables with normal distribution according to the distribution normality analysis of the obtained data. We determined the statistical significance level as the p value= 0.05. We interpreted the $p<0.05$ value as the presence of a statistically significant difference, whereas we evaluated the $p>0.05$ value as the absence of a significant difference.

Table 1

Statistical difference of myocyte damage between groups and Mean±Standard deviation values of damage scoring.

		DIVERTICULUM (D)						Chi-Square Analysis	
		D		D-NO		Total			
		n	%	n	%	n	%	Chi-Square	p
Ascending Aort Diameter	30-39 mm (Normal)	30	75,0	10	25,0	40	100,0	2,5	0,287
	40-49 mm (aneurysm)	34	72,3	13	27,7	47	100,0		
	50+	5	50,0	5	50,0	10	100,0		
	Total	69	71,1	28	28,9	97	100,0		
Plate Degree	No plate	38	66,7	19	33,3	57	100,0	0,735	0,391
	little	30	76,9	9	23,1	39	100,0		
	Total	68	70,8	28	29,2	96	100,0		
Descending Aort Diameter	-30 mm	19	65,5	10	34,5	29	100,0	-	0,691
	30-50mm	46	73,0	17	27,0	63	100,0		
	50+ mm	4	80,0	1	20,0	5	100,0		
	Total	69	71,1	28	28,9	97	100,0		
Plate	no	12	66,7	6	33,3	18	100,0	0,031	0,861
	yes	57	72,2	22	27,8	79	100,0		
	Total	69	71,1	28	28,9	97	100,0		
Abdominal Aort Diameter	20-29 mm	19	55,9	15	44,1	34	100,0	6,03	0,047
	30-49 mm	27	81,8	6	18,2	33	100,0		
	50+ mm	23	76,7	7	23,3	30	100,0		
	Total	69	71,1	28	28,9	97	100,0		

$p<0.05$ statistically significant

Table 2
Relationship between abdominal vascular nutritional status and presence of colonic diverticulum

		DIVERTICULUM						Chi-Square Analysis	
		D		D-NO		Total			
		n	%	n	%	n	%	Chi-Square	p
	no	3	50,0	3	50,0	6	100,0		
	yes	58	71,6	23	28,4	81	100,0		
Plate	middle	4	66,7	2	33,3	6	100,0	-	0,408
	heavy	4	100,0	0	0,0	4	100,0		
	Total	69	71,1	28	28,9	97	100,0		
	no	42	71,2	17	28,8	59	100,0		
	little	21	75,0	7	25,0	28	100,0		
Gastrointestinal Impact Number	middle	5	62,5	3	37,5	8	100,0	-	0,905
	heavy	1	50,0	1	50,0	2	100,0		
	Total	69	71,1	28	28,9	97	100,0		
	no	42	71,2	17	28,8	59	100,0		
Gastrointestinal Impact Number	yes	27	71,1	11	28,9	38	100,0	0	1
	Total	69	71,1	28	28,9	97	100,0		
	no	30	63,8	17	36,2	47	100,0		
Sma Plate	yes	39	78,0	11	22,0	50	100,0	1,7	0,189
	Total	69	71,1	28	28,9	97	100,0		
	yok	30	63,8	17	36,2	47	100,0		
	little	31	75,6	10	24,4	41	100,0		
Sma Plate %	middle	7	87,5	1	12,5	8	100,0	-	0,389
	heavy	1	100,0	0	0,0	1	100,0		
	Total	69	71,1	28	28,9	97	100,0		
	no	45	71,4	18	28,6	63	100,0		
İma Plate	yes	24	70,6	10	29,4	34	100,0	0,008	0,931
	Total	69	71,1	28	28,9	97	100,0		
	plate no	45	71,4	18	28,6	63	100,0		
	little	2	40,0	3	60,0	5	100,0		
İma Plate %	middle	5	100,0	0	0,0	5	100,0	-	0,378
	heavy	3	75,0	1	25,0	4	100,0		
	fully obstructed	14	70,0	6	30,0	20	100,0		
	Total	69	71,1	28	28,9	97	100,0		

p>0.05 not statistically insignificant SMA: superior mesenteric artery, İMA: inferior mesenteric artery

3. Results

The rate of diverticulum (D) in those with an abdominal aortic diameter of 20-29 mm was found to be significantly lower than the groups with an abdominal aortic diameter of 30-49 mm and 50+ mm (Table 1) (p<0.05). Aortic degeneration may start with endothelial malnutrition, atherosclerosis, and plaque formation and progress to narrowing and stenosis.

There was no relationship between the presence/absence of plaque and the presence of diverticulum (p>0.05). We determined no relationship also between normal and aneurysmatic diameters Dilatation and aneurysmatic wall weakness may develop a progressive process. In this respect, the presence of colonic diverticulum was evaluated based on the severity of plaque formation in vascular involvement and the degree of dilatation across several diameters. of ascending and descending aorta with the formation of the diverticulum (p>0.05). On the other hand, there was no relationship between the normal abdominal aortic diameter of 20-29 mm and the development of a diverticulum, whereas the detection rate increased as abdominal aortic diameter (30-49mm,

50+ mm) increased. We found this relationship statistically significant ($p<0.05$). Increased pressure, as one of the etiological factors in the development of an aneurysm, may be associated with increased colonic intraluminal pressure that leads to the development of the diverticulum (Table 1).

We evaluated vascular involvement concerning the level of plaque formation in SMA and IMA of the abdominal aorta that supplies the intestine (Table 2). We determined no statistically significant relationship between the plaque formation level and colonic diverticulum presence.

As vascular degeneration reached aneurysmal dilatation of abdominal aortic diameter, the probability of colonic diverticulum development was found to increase statistically significantly. (Table 2). Total stenosis in the SMA and IMA was not found to increase the likelihood of diverticula formation. That outcome supports the consideration that the development of diverticulum is associated with increased pressure rather than malnutrition.

4. Discussion

Atherosclerosis is accepted as an independent risk factor in aortic aneurysm development[9]. Also, in our study, no correlation between plaque formation that supports atherosclerosis and aneurysm was found. Consequently, the incidence of colonic diverticulum did not increase in patients with plaque lesions.

According to Laplace's law, increased pressure is the etiological factor in aneurysm development[10]. Increased colonic pressure is also effective in the development of the colonic diverticulum[11]. Increased pressure causes the weakening of circular colonic muscles. Pericolic fat tissue out of these weakened colon muscles protrudes together with colonic muscularis mucosa. An increase in ascending or descending aortic aneurysms did not increase the tendency for colonic diverticulum formation, but it is increased in abdominal aortic aneurysms.

This situation suggests that elevated intra-abdominal pressure results in the development of aneurysms at the vascular level and diverticula at the organ level. The increased detection of colonic diverticulum in patients with abdominal aortic aneurysm additionally suggests this in our study.

5. Conclusions

We concluded that patients who underwent tomography control due to an aneurysm should also be evaluated for the presence and treatment of colonic diverticulum.

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Statement of ethics

The study was approved by the University of Giresun Ethics Committee (05.12.2019-04) and was conducted in accordance with the Declaration of Helsinki.

Conflict of interest statement

The authors declare that they have no financial conflict of interest with regard to the content of this report.

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Author contributions

All authors contributed to the design and writing of the study. All authors reviewed and accepted the final version of the study.

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