

## Prevalence and clinical features of colonic diverticulosis in a Middle Eastern population

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### Abstract

**AIM:** To determine the prevalence, location, associations and clinical features of colonic-diverticulosis and its role as a cause of lower-gastroenterology-bleeding.

**METHODS:** We retrospectively reviewed the medical records of 3649 consecutive patients who underwent a colonoscopy for all indications between 2007 and 2011 at King Khalid University Hospital, Riyadh, Saudi Arabia. The demographic data were collected retrospectively through the hospital's information system, electronic file system, endoscopic e-reports, and manual review of the files by two research assistants. The demographic information included the age, sex, comorbidities and indication for the colonoscopy. The association among colonic polyps, comorbidities and diverticular disease was also measured.

**RESULTS:** A total of 270 patients out of 3649 were diagnosed with colonic diverticulosis, with a prevalence of 7.4%. The mean age was 60.82 years  $\pm$  0.833, (range 12-110). Females comprised 38.89% (95%CI: 33-44.7) of the study population. The major symptoms were rectal bleeding in 33.6%, abdominal pain in 19.3%, constipation in 12.8% and anemia in 6%. Diverticula were predominantly left-sided (sigmoid and descending colon) in 62%, right-sided in 13% and in multiple locations in 25%. There was an association between the presence of diverticulosis and adenomatous polyps ( $P$ -value  $<$  0.001), hypertension ( $P$ -value  $<$  0.0001) and diabetes mellitus ( $P$ -value  $<$  0.0016). Diverticular disease was the second most common cause of lower gastrointestinal bleeding, in 33.6% (95%CI: 27.7-39.4), after internal hemorrhoids, in 44.6% (95%CI: 40.3-48.9). On multivariable logistic regression, hypertension (OR = 2.30; 95%CI: 1.29-4.10), rectal bleeding (OR = 2.57; 95%CI: 1.50-4.38), and per year increment in age (OR = 1.05; 95%CI: 1.03-1.07) were associated with diverticulosis but not with bleeding diverticular disease. Limitations: A small proportion of the patients included had colonoscopies performed as a screening test.

**CONCLUSION:** Colonic-diverticulosis was found to have a low prevalence, be predominantly left-sided and associated with adenomatous-polyps. Age, hypertension and rectal bleeding predict the presence of diverticular disease.

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**Key words:** Colonic diverticulosis; Diverticular disease; Saudi Arabia; Prevalence; Lower gastrointestinal bleeding; Epidemiology

**Core tip:** Colonic-diverticulosis is common in Western populations as well as an emerging disease in Eastern populations but prevalence data for Arab populations is scarce. We retrospectively reviewed the medical

records of 3649 consecutive patients who underwent a colonoscopy for all indications. The demographic information included the age, sex, comorbidities and indication for the colonoscopy. The association among colonic polyps, comorbidities and diverticular disease was also measured. Colonic-diverticulosis was found to have a low prevalence among the Saudi population, be predominantly left-sided and associated with adenomatous-polyps. Age, hypertension and rectal bleeding predict the presence of diverticular disease.

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## INTRODUCTION

Diverticulosis of the colon is a common disease in Western societies<sup>[1]</sup>. Although the true prevalence of diverticula is unknown, a large observational study of 9086 consecutive patients undergoing colonoscopy found a prevalence of 27%<sup>[2]</sup>, which increased with advancing age. Some studies suggested that the prevalence of diverticula may be as high as 60% in patients older than 80 years of age<sup>[3]</sup> and has no sex predilection. Most patients with diverticulosis will have clinically quiescent disease; approximately 80% to 85% are believed to remain asymptomatic.

Recent evidence showed a rising prevalence of diverticulosis in Europe, the United States and Canada<sup>[4-6]</sup>. Although Western populations have predominantly left-sided diverticulosis<sup>[7]</sup>, right-sided diverticulosis is common in Asia. Diverticulosis of the colon is rare in rural Asia and Africa, and its incidence increases with age<sup>[8-15]</sup>. The prevalence in Southeast Asia ranges from 8% to 22%<sup>[8,9]</sup>, affecting the right side of the colon in most cases (70%-98%) and showing a peak incidence in patients 50 to 60 years of age<sup>[10,11]</sup>. Studies from China and South Korea have noted a prevalence of 0.5% to 1.7% with a right-side predilection in 75% of the patients<sup>[12]</sup>. However, an even lower prevalence of diverticulosis was reported in Sub-Saharan Africa, with a slightly younger age (45 to 60 years) with right colon involvement in 62% of the cases<sup>[13-15]</sup>. Data from the Arab world examining the prevalence and clinical features of colonic diverticulosis are scant. In a retrospective evaluation of 274 consecutive barium enemas performed at a single institute in patients aged 20 to 85 years over a three-year period (1979 to 1981) in Jordan, colonic diverticula were found in 4%<sup>[16]</sup>. A study from Iran examined the frequency of diverticulosis in 656 barium enemas and found it to be 2.4% in patients older than 50 years<sup>[17]</sup>. A higher prevalence was reported in Israel, reaching up to 9.5% among Arabs, with a seven-fold increase over a 10-year period<sup>[18]</sup>. Diverticular disease (DD) refers to symptomatic diverticula

that cause complications, including acute diverticulitis, perforations and lower gastrointestinal bleeding. Bleeding from colonic diverticula is the most common cause of acute lower gastrointestinal (GI) bleeding<sup>[19,20]</sup>. Acute lower intestinal bleeding has been reported to occur in up to 3%-5% of colonic diverticula<sup>[21,22]</sup>. Most cases of diverticular bleeding resolve on their own, and diverticular bleeding stops spontaneously in 70%-80% of cases<sup>[23]</sup>. Shennak *et al.*<sup>[24]</sup> reported that hemorrhoids were the most common cause of lower GI bleeding in 701 Jordanian patients, followed by polyps and colitis. No data are available from Saudi Arabia, and whether the incidence, prevalence or epidemiology of the disease is similar or differs from that in other populations is not clear. The aim of our study was to investigate the prevalence, location, distribution, clinical features and associations of colonic diverticulosis as well as the factors that contribute to bleeding in Saudi patients with DD.

## MATERIALS AND METHODS

### Ethics

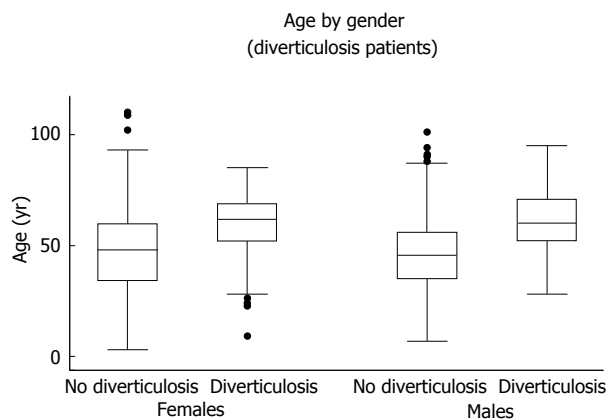
This study was approved ethically by the Internal Review Board (IRB) (Study No. E-12-818) at King Khalid University Hospital, Riyadh, Saudi Arabia.

### Data Collection

A retrospective cohort study was conducted using an endoscopic reporting database of individuals seen at a major tertiary care university hospital (King Khalid University Hospital) in Riyadh, Saudi Arabia. The demographic data of consecutive patients who underwent a complete colonoscopy for all indications between August 2007 and April 2011 were collected retrospectively through the hospital's HIS system, electronic file system, endoscopic e-reports, and a manual review of the files by two research assistants. The demographic features included age, sex, symptoms, indication for colonoscopy, medication history and comorbidities. Patients with a history of any of the following were excluded from this study: colon cancer, colonic resection, incomplete colonoscopy, active colitis, active diverticulitis and inflammatory bowel disease. Colonic diverticulosis was defined as the presence of one or more diverticula, which is a saccular out pouching of the colon. The location of the diverticula was classified as follows: left-sided refers to diverticulosis involving the descending colon and/or sigmoid colon with or without the transverse colon, right-sided refers to diverticulosis involving the caecum and/or ascending colon with or without the transverse colon and hepatic flexure, and multiple locations refers to both right and left colonic involvement. The ethics committee of King Khalid University Hospital approved the study.

### Statistical analysis

Descriptive statistics were computed for continuous variables including means, SD and minimum and maximum values. Frequencies and inter-quintile ranges were used



**Figure 1** The age distribution of patients stratified by the presences or absence of diverticulosis as well as gender. Source: King Khalid University Hospital.

for categorical variables. The  $\chi^2$  test was used for categorical variables, and the *t*-test for continuous variables. Univariable and multivariable logistic regressions were used to examine the association between independent variables and the presence of diverticulosis. The OR and 95%CI were estimated. We used the software STATA 11.2 (StataCorp, TX, United States) in our analysis. A *P*-value of < 0.05 was considered statistically significant.

## RESULTS

Out of 3649 patients undergoing colonoscopy, 270 patients (7.4%) were diagnosed with colonic diverticulosis. The mean age was 60.82 years  $\pm$  0.833 (range 12-110), and the majority were Saudi nationals (92.9%). Females were 38.89%  $\pm$  2.97 and males were 61.11%  $\pm$  1.51 of the cohort, and there was no gender-specific predilection (*P* < 0.218) (Figure 1). The comorbidities and the indications for the colonoscopy for all patients are presented in Table 1. Diverticulosis was predominantly left-sided (sigmoid and descending colon) in 62%, followed by right-sided in 13% and multiple locations in 25%.

In the patients with diverticulosis, there was a higher history of hypertension (63.88% *vs* 25.92%, *P*-value < 0.01), diabetes (44.44% *vs* 24.32%, *P*-value < 0.01), dyslipidemia (22.22% *vs* 10.77%, *P*-value = 0.03) and a higher history of the use of aspirin (21.33% *vs* 9.23%, *P*-value = 0.01). Furthermore, those with diverticulosis were referred for a colonoscopy more frequently for rectal bleeding (33.60% *vs* 22.08%, *P*-value < 0.01) and were less likely to be referred for surveillance (10.40% *vs* 16.72%, *P*-value < 0.01), diarrhea (2.40% *vs* 9.28%, *P*-value < 0.01), or weight loss (2.00% *vs* 5.79%, *P*-value < 0.01) (Table 1).

The univariable analysis revealed that diverticulosis was associated with a history of hypertension (OR = 5.05; 95%CI: 3.06-8.34), diabetes (OR = 2.49; 95%CI: 1.53-4.05), dyslipidemia (OR = 2.37; 95% CI, 1.31-4.27), and aspirin use (OR = 2.67; 95%CI: 1.48-4.81) and that the diverticulosis patients were more likely to be

**Table 1** Comorbidities of patients and indications for a colonoscopy for the complete cohort of patients

Variable	Percentage	95%CI
<b>Comorbidities</b>		
Hypertension	63.88%	52.52-75.25
Diabetes	44.44%	32.68-56.20
Dyslipidemia	22.22%	12.38-32.06
Aspirin	10.07%	8.35-11.82
Chronic kidney disease	5.55%	0.10-11.00
Coronary artery disease	4.16%	0.10-9.00
<b>Indication for colonoscopy</b>		
Bleeding per rectum	22.94%	21.50-24.38
Abdominal pain	19.30%	17.94-20.64
Surveillance	16.29%	15.03-17.55
Constipation	9.57%	8.57-10.58
Diarrhea	8.75%	7.79-9.72
Screening	7.57%	6.67-8.48
Weight loss	5.50%	4.72-6.28
Anemia	5.02%	4.27-5.76
Melena	3.13%	2.54-3.73
Anal pain	1.91%	1.45-2.38
Altered bowel habits	1.76%	1.31-2.21
Perianal fistula	1.19%	0.82-1.55
Positive for occult blood	0.52%	0.27-0.76

referred for a colonoscopy for rectal bleeding (OR = 1.79; 95%CI: 1.35-2.35) but less likely to be referred for surveillance (OR = 0.58; 95%CI: 0.38-0.87), diarrhea (OR = 0.24; 95%CI: 0.11-0.55), or weight loss (OR = 0.33; 95%CI: 0.14-0.82) (Table 2).

The multivariable analysis revealed that the only factors associated with the presence of diverticulosis were age (OR = 1.05; 95%CI: 1.03-1.07 per year), hypertension (OR = 2.30; 95%CI: 1.29-4.10), rectal bleeding (OR = 2.57; 95%CI: 1.50-4.38), and the finding of internal hemorrhoids (OR = 1.96; 95%CI: 1.06-3.65) (Table 3). However, none of these variables predicted bleeding in the patients with DD (Table 4).

There was an association between the presence of diverticulosis and adenomatous polyps (OR = 1.76; 95%CI: 1.33-2.33).

Regarding the etiology of the patients presenting with rectal bleeding based on the colonoscopy findings, internal hemorrhoids was the most common cause (44.7%), followed by DD (33.6%), colonic mass (31.5%), polyps (24.8%), and colitis (19.0%) (Table 5).

We found that bleeding as an indication for a colonoscopy was present in 58% of the patients with left-sided DD, 18% with right-sided DD, and 23% with DD in multiple locations.

## DISCUSSION

Colonic diverticulosis is a prevalent gastrointestinal disorder in Western populations and less so in Eastern ones<sup>[4,25,26]</sup>. Ascertaining the true prevalence of diverticulosis in the general population is difficult given that most affected individuals will remain asymptomatic. Our knowledge about the magnitude of the effect and prevalence in Arab populations is limited. The results

**Table 2 Comorbidities of patients and indications for a colonoscopy stratified by the presence and absence of diverticulosis as well as the univariable analysis between the presence of diverticulosis and the corresponding variables**

Variable	Diverticulosis	No diverticulosis	P-value	Univariable analysis	
				OR	95%CI
<b>Comorbidities</b>					
Hypertension	63.88%	25.92%	< 0.01	5.05	3.06-8.34
Diabetes	44.44%	24.32%	< 0.01	2.49	1.53-4.05
Dyslipidemia	22.22%	10.77%	0.03	2.37	1.31-4.27
Aspirin	21.33%	9.23%	0.01	2.67	1.48-4.81
Chronic kidney disease	5.56%	3.12%	0.38	2.91	0.82-10.29
Coronary artery disease	4.16%	1.43%	0.27	1.82	0.62-5.30
<b>Indication for colonoscopy</b>					
Bleeding per rectum	33.60%	22.08%	< 0.01	1.79	1.35-2.35
Abdominal pain	19.30%	15.20%	0.06	0.73	0.51-1.05
Constipation	12.80%	9.31%	0.11	1.43	0.96-2.11
Surveillance	10.40%	16.72%	< 0.01	0.58	0.38-0.87
Screening	6.40%	7.67%	0.43	0.82	0.49-1.39
Anemia	6.00%	4.94%	0.5	1.23	0.71-2.12
Melena	3.13%	4.40%	0.31	1.47	0.78-2.79
Diarrhea	2.40%	9.28%	< 0.01	0.24	0.11-0.55
Altered bowel habits	2.00%	1.74%	0.78	1.15	0.46-2.90
Weight loss	2.00%	5.79%	< 0.01	0.33	0.14-0.82
Anal pain	1.20%	1.97%	0.29	0.6	0.19-1.94
Positive for occult blood	1.20%	0.46%	0.29	2.62	0.75-9.19
Perianal fistula	0.40%	1.25%	0.06	0.32	0.04-2.32

**Table 3 Variables associated with the presence of diverticulosis on multivariable analysis**

Variable	Multivariable analysis	
	OR	95%CI
Age	1.05	1.03-1.07
Hypertension	2.30	1.29-4.10
Bleeding per rectum	2.57	1.50-4.38
Internal hemorrhoids	1.96	1.06-3.65

**Table 4 Factors associated with of bleeding per rectum in those with diverticulosis on univariable analysis, none of the variables were associated with bleeding per rectum on multivariable analysis**

Variable	OR	95%CI
Age	1.00	0.97-1.02
Hypertension	0.73	0.27-1.95
Diabetes	1.27	0.48-3.32
Dyslipidemia	1.00	0.32-3.15
Atrial fibrillation	0.44	0.05-3.50
Abdominal Pain	0.19	0.07-0.57
Constipation	0.75	0.33-1.70
Diarrhea	0.39	0.04-3.38
Internal hemorrhoids	2.61	1.48-4.61
Polyps	1.28	0.72-2.29

of this study showed that the prevalence of colonic diverticulosis is 7.4%, which is low compared with Western and Eastern populations and slightly higher compared with data from other countries in the Arab world<sup>[16,17]</sup>.

The mean age of the patients with diverticulosis was 60.82 years, and the majority (92.3%) were older than 50 years of age. The disease was more prevalent

**Table 5 Findings on colonoscopy and possible etiologies for patients referred for bleeding per rectum**

Etiology	Percentage	95%CI
Internal hemorrhoids	44.66%	40.36-48.96
Diverticulosis	33.60%	27.73-39.47
Mass	31.45%	26.03-36.87
Polyps	24.76%	21.37-28.15
Colitis	18.97%	14.44-23.49

with advancing age, which is in agreement with the international data<sup>[27]</sup>.

The distribution pattern of diverticulosis differs between Western and Eastern populations, with sigmoid diverticula predominating in the Western population and the right colon most commonly affected in Asians<sup>[28-30]</sup>. Left-sided diverticulosis was found to be more common, which is most likely due to urbanization in the gulf region, with the increased consumption of red meat and a low fiber diet. The study was conducted in one of the largest tertiary care hospitals in Riyadh, the capital of the Kingdom of Saudi Arabia. The caption area of the hospital covers the population inhabiting the northern part of Riyadh, which has an urban inhabitation. Right colonic diverticulosis is thought to be congenital, which differs from the development of sigmoid diverticula, which in turn is thought to be acquired as a result of the raised intraluminal pressure within the colon<sup>[31]</sup> that is attributable to inadequate dietary fiber intake<sup>[32,33]</sup>.

Colonic neoplasia and colonic diverticulosis have common epidemiological trends and risk factors, such as age and a lack of dietary fiber<sup>[34]</sup>. However, the association between these diseases remains elusive. In a pro-

spective study, Morini *et al*<sup>[35]</sup> found an increased risk for sigmoid colon adenomas in Italian patients with DD. In a cross-sectional study in the United States, an increased risk for distal neoplasia was found in women with extensive distal diverticulosis<sup>[36]</sup>. Such an association was also observed in our study (OR = 1.76; 95%CI: 1.33-2.33), with a predominantly left-sided location for diverticulosis in 62% and for adenomatous polyps in 65% of our cohort.

Studies have shown that NSAID use in patients with complicated DD is nearly double the rate of NSAID use in patients with normal, healthy colons<sup>[37]</sup>. In addition, multiple studies have demonstrated a clear link between NSAID use and an increased risk of diverticular hemorrhaging. Hypertension was also found to be associated with the risk of DD complicated with a high bleeding risk, which is predominantly due to vascular endothelial injury and atheroma formation that lead to arteriosclerosis and increased pressure within exposed blood vessels, which elevate the risk for bleeding<sup>[38,39]</sup>. Sakuta *et al*<sup>[40]</sup> reported the first study that evaluated the prevalence rates of type 2 diabetes and hypertension among the subjects with asymptomatic colonic diverticula and found that type 2 diabetes (21.6% *vs* 14.0%, *P* = 0.047) and hypertension (30.9% *vs* 19.8%, *P* = 0.011) were more prevalent among the subjects with colonic diverticulum than in those without it. The mechanism of the association between diabetes and colonic diverticula is not yet clear. However, low dietary fiber intake is assumed to contribute to the development of colonic diverticula<sup>[41-43]</sup>. Our data showed similar associations with hypertension, diabetes mellitus, dyslipidemia, the history of aspirin use and colonic diverticulosis, but the only factors that predicted the presence of colonic diverticulosis were age (OR = 1.05; 95%CI: 1.03-1.07 per year), hypertension (OR = 2.40; 95%CI: 1.31-4.39), rectal bleeding (OR = 2.57; 95%CI: 3.06-8.34), and the finding of internal hemorrhoids (OR = 1.96; 95%CI: 1.06-3.65). Surprisingly, these factors were not associated with complicated diverticulosis patients who presented with lower GI bleeding.

Before the era of the colonoscopy, DD was thought to be the most common cause of massive lower GI bleeding<sup>[44]</sup>, as it was often diagnosed by barium enemas in earlier studies. Recently after the introduction of colonoscopy, however, DD was shown to be the second-most common etiology of massive GI bleeding in the elderly after colonic angiodysplasia<sup>[45]</sup>. Our data found that internal hemorrhoids were the most common etiology of rectal bleeding, with DD being second. This result is likely related to the retrospective study design.

Our study may have suffered bias towards symptomatic patients because it was an observational study instead of a population-based study. In addition, because of the limited number of patients with screening colonoscopy as an indication, a definitive conclusion could not be drawn, especially given the lack of previous studies from Saudi Arabia or Gulf countries for

comparison. However, this study is the first, to the best of our knowledge, evaluating the prevalence, clinical features, and associations of colonic diverticulosis in Saudi Arabia and may open the door for future research with a larger cohort to elucidate the true prevalence, behavior, risk factors and association of DD in our population.

## COMMENTS

### Background

Colonic diverticulosis is common in Western populations as well as an emerging disease in Eastern populations but data are scarce about the prevalence among the Arab population with no previous reported studies on the prevalence of diverticular disease.

### Research frontiers

Diverticulosis of the colon is a common disease in the Western populations and associated with many gastrointestinal complications that might be life threatening as in case of lower gastrointestinal (GI) bleeding. The prevalence of colonic diverticulosis have been studied thoroughly in Western and Eastern populations, however it was never studied in Arab or among gulf populations. In this study, the authors aimed to look at the prevalence, clinical pictures, and locations of colonic diverticulosis as well as it's role to the patients who presented with lower GI bleeding.

### Innovations and breakthroughs

The study demonstrate that the colonic diverticulosis prevalence among Saudi population was low compared to the reported prevalence from the other ethnic population, however colonic diverticula were predominantly at the left side similar to Western populations. Other important issue was being associated with the presence of adenomatous polyps in left side of the colon. It's role in contributions of lower GI bleeding was also studied and found that diverticular disease was the second most common etiology for lower GI bleeding in these cohort.

### Applications

Future population based studies to look at the true prevalence of colonic diverticulosis among patients for screening colonoscopy are highly recommended.

### Peer review

The manuscript underlies the prevalence, clinical pictures, locations, and association of colonic diverticulosis among Saudi populations which never been studied before and it looks also at the factors that predict the presence of colonic diverticula which might help in patients selection to undergo colonoscopic studies. It is well written manuscript in an important GI topic.

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