RESEARCH ARTICLE

What are the Endoscopic and Pathological Characteristics of Colorectal Polyps?

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Abstract

  Background: Colon polyps need to be excised upon detection during colonoscopy due to the risk of malignancy irrespective of their size. In our study, we retrospectively evaluated the clinicopathological characteristics of polyps detected during colonoscopy. **Materials and Methods:** We assessed 379 patients with polyps detected during colonoscopy between January 2010 and May 2012. The demographics, complaints, colonoscopy findings (shape, place and size of the polyp) and histopathological findings were recorded. We carried out statistical analysis using PASW 18.0 for Windows. **Results:** There were 227 males (59.9%) and 152 females (40.1%) in the trial. The mean age was 53.8 years (32-90). The most common complaint was rectal bleeding (36.1%), followed by abdominal pain (35.4%). Polyps were detected most commonly in the rectosigmoid region (43.8%), followed by the descending colon (17.4%). Some 239 patients had a single polyp (63.1%) while 140 were found to have multiple polyps (36.9%). While tubular adenoma was the most common pathological type, occurring in 181 patients (47.8%), tubulovillous adenoma (14.2%) and hyperplastic polyp (12.7%) followed, occurring in 54 and 48 patients respectively. While 313 patients (82.6%) did not feature dysplasia, 37 patients (9.7%) exhibited low-grade dysplasia, 28 (7.7%) had high-grade dysplasia and 4 had cancer (1.1%). The rates of villous components and dysplasia were detected to be high among pedunculated polyps and polyps larger than 1 cm (p<0.001). **Conclusions:** Due to the fact that large-diameter polyps with malignant potential are commonly located in the left colon and have a high prevalence among the middle-aged individuals, it would be appropriate to screen this population at regular intervals via rectosigmoidoscopy.

  Keywords: Colonoscopy - polypectomy - dysplasia - cancer

Introduction

The structures, which protrude from the mucosa or submucosa towards the lumen in the gastrointestinal system, are called polyps (Anwar et al., 1999; Hodadoostan et al., 2010). Polyps need to be excised upon detection during colonoscopy due to the risk of malignancy irrespective of their size. The polyps detected during colonoscopy are defined by the morphological appearance (pedunculated, sessile) and size (Itzkowitz and Potack, 2006; Shussman and Wexner, 2014). Histopathologically, polyps are divided into two main groups as neoplastic and non-neoplastic (Li et al., 2014). Non-neoplastic polyps are classified into the groups of inflammatory, hyperplastic and hamartomatous while neoplastic polyps are classified as tubular, tubulovillous and villous adenoma (Karaman et al., 2013; Shussman and Wexner, 2014). Adenomas contain dysplasia irrespective of the size and need to be monitored (Winawer et al., 2006; Iravani et al., 2014). In this trial, we assessed the prevalence, the location and the histopathology results of the polyps detected during colonoscopy performed upon presentation with various complaints.

Materials and Methods

Study design

The study was a single-center, cross-sectional clinical trial, which included a retrospective assessment of the colonoscopy data and pathology reports. All endoscopy investigations were carried out by a single gastroenterologist. The biopsies obtained were assessed by independent pathologists, who were blinded to the history of the patient.

Patients and procedures

The study was conducted at the gastroenterology clinic of a state hospital in Turkey between January 2010 and May 2012. The patient group consisted of the patients, who were referred from the gastroenterology, general surgery departments of the hospital, and the general outpatients. Similarly, the patients referred from the other hospitals were also evaluated. The patient population included those patients who were detected to have polyps and underwent polypectomy during colonoscopy performed for various indications.

The patient group was planned to include patients

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within the age range of 18 and 80 years. Patients with rectal hemorrhage, abdominal pain, irritable bowel syndrome (IBS) symptoms or those who had no complaints and underwent colonoscopy for screening purposes were included in the trial. Patients below the age of 18, patients with malignant appearing lesions, inflammatory bowel disease or suspected polyposis coli syndrome, colon cancer or polyposis history and those with previous colon resection were excluded.

All the colonoscopy procedures were carried out by a single gastroenterologist using Fujinon EG 450 WL5 and Pentax EG-2980 K videogastroscopy devices. All patients underwent colon irrigation. 3 days before the procedure, the patients were advised to consume liquid food products. One day before the procedure, the patients were administered two doses of laxatives containing 250cc sennosides A and B or 45cc phospho soda. In addition, the patients also underwent a procedure of enema with two doses of disodium phosphate and disodium phosphate or sodium dihydrogen phosphate and disodium hydrogen phosphate for cleansing the distal colon. The patients were informed before the procedure and gave written consent. All the procedures were performed in the form of pancolonoscopy involving caecal intubation. The patients were sedated with midazolam.

Histopathological sampling was performed for all the polyps detected during colonoscopy. Polyp localizations were reported as rectosigmoid colon, descending colon, transverse colon, ascending colon, cecum and the whole colon. The size was recorded as < 1 cm or > 1 cm. Also, the polyps were divided into three groups as flat, sessile and pedunculated on a colonoscopy basis.

In accordance with the pathology criteria described by the World Health Organization for colon lesions, they were classified as hyperplastic, precancerous (serrated, tubular, tubular-villous, and villous), and cancer.

Statistical analysis

PASW 18.0 for Windows was used for conducting the statistical analysis. In pairwise and multiple group comparisons for categorical independent variables, chi-square test was used; and when the condition of the chi-square was not met, the Monte Carlo Simulation was used in multiple group comparisons. A p-value lower than 0.05 was considered to indicate statistical significance.

Results

A total of 379 patients, including 227 males (59.9%) and 152 females (40.1%), were enrolled in the trial. The mean age was 53.8 (32-90); the number of patients within the age range of 40 and 49 was 124 (32.7%) and this was the largest group, followed by the group of 117 patients within the age range of 50 and 59 (30.9%). The number of patients within the age range of 32 and 39 and the elderly age group above 60 years constituted 21 (5.5%) and 117 (30.9%) respectively. The complaints of rectal bleeding and abdominal pain were the most common complaints reported by the patients. For screening purposes, colonoscopy was performed in 61 patients (16.1%). The number of patients between 40 and 49 years was statistically higher in the IBS group compared to that in the other groups (p<0.001) (Table 1). The polyp was detected in the rectosigmoid region in 65% of the patient presenting with rectal bleeding (p<0.001). There was no statistical difference between the histopathological types by symptomatology. However, patients with bleeding complaints were observed to have a higher rate of malignant change and villous formation. All of the cancer patients were detected to have a rectal bleeding complaint. However, since the number of cancer patients was small, these patients were excluded from the statistical assessment. Dysplasia was detected at a rate of 21%,

Table 1. Symptom Distribution by Age, Location, Histological Type and Dysplasia Type

Age (year)	n (%)	Rectal bleeding	Abdominal pain	IBS	Screening	p
	32-39	10 (7.3)	6 (4.5)	4 (8.5)	1 (1.6)	<0.001
	40-49	36 (26.3)	34 (25.4)	36 (76.6)*	18 (29.5)	
	50-59	37 (27)	46 (34.3)	6 (12.8)	28 (45.9)	
	60-69	34 (24.8)	44 (32.8)	1 (2.1)	8 (13.1)	
	70-70+	20 (14.6)	4 (3)	0 (0)	6 (9.8)	
Location	Cecum	0 (0)	11 (47.8)	8 (34.8)	4 (17.4)	<0.001
	Ascending Colon	0 (0)	20 (54.1)	10 (27)	7 (18.9)	
	Transverse Colon	0 (0)	20 (52.6)	4 (10.5)	14 (36.8)	
	Descending Colon	15 (22.7)	35 (53)	6 (9.1)	10 (15.2)	
	Rectosigmoid Colon	119 (65)*	37 (20.2)	11 (6)	16 (8.7)	
	All Colon	3 (9.4)	11 (34.4)	8 (25)	10 (31.3)	
Histopathological Type	HPA	18 (37.5)	15 (31.3)	6 (12.5)	9 (18.8)	NS
	INF	12 (40)	9 (30)	2 (6.7)	7 (23.3)	
	Mucosa	7 (21.2)	8 (24.2)	10 (30.3)	8 (24.2)	
	TA	66 (36.5)	72 (39.8)	20 (11)	23 (12.7)	
	TVA	20 (37)	21 (38.9)	4 (7.4)	9 (16.7)	
	VA	13 (44.8)	7 (24.1)	4 (13.8)	5 (17.2)	
	CA	4 (100) ‡	0 (0)	0 (0)	0 (0)	
Dysplasia Type	High-Grade Dysplasia	12 (44.4)	10 (37)	1 (3.7)	4 (14.8)	NS
	Low-Grade Dysplasia	17 (48.6)	9 (25.7)	5 (14.3)	4 (11.4)	
	None	106 (34.2)	112 (36.1)	40 (12.9)	52 (16.8)	

*Group that makes the difference, ‡Because of the small number, these were not to be evaluated; Hyperplastic Adenoma (HPA), Inflammatory Polyp (INF), Tubular Adenoma (TA), Tubulovillous Adenoma (TVA), Villous Adenoma (VA), Carcinoma (CA), IBS: Irritable Bowel Syndrome

Table 2. The Relationship between the Appearance of Polyps and Histopathology and Dysplasia

n (%)	Histopathological Findings							
	HPA	INF	Mucosa	TA	TVA	VA	CA	p
Flat	14 (29.2)	30 (100)	8 (24.2)	9 (5)	4 (7.4)	0 (0)	0 (0)	<0.001
Pedunculated	7 (14.6)	0 (0)	2 (6.1)	124 (68.5)	42 (77.8)	28 (96.6)	4 (100)	
Sessile	27 (56.3)	0 (0)	23 (69.7)	48 (26.5)	8 (14.8)	1 (3.4)	0 (0)	
n (%)	Dysplasia Type							
	High-Grade Dysplasia		Low-Grade Dysplasia		None			p
Flat	0 (0)		0 (0)		65 (21)			<0.001
Pedunculated	28 (100)		35 (94.3)		140 (45.2)			
Sessile	0 (0)		2 (5.7)		105 (33.9)			

*Hyperplastic Adenoma (HPA), Inflammatory Polyp (INF), Tubular Adenoma (TA), Tubulovillous Adenoma (TVA), Villous Adenoma (VA), Carcinoma (CA)

Table 3. The Relationship between the Polyp Size and Histopathology and Dysplasia

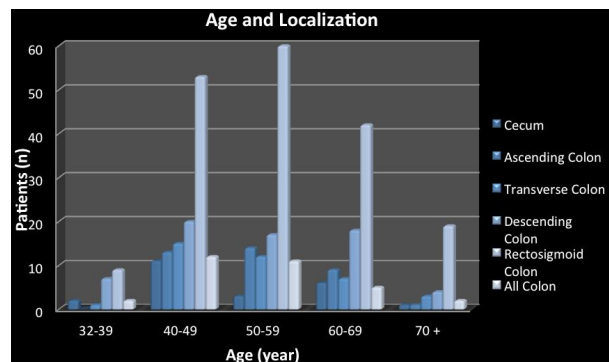| n (%)	Histopathological Findings							
	HPA	INF	Mucosa	TA	TVA	VA	CA	p
<1cm	44 (91.7)	30 (100)	33 (100)	67 (37)	14 (25.9)	0 (0)	0 (0)	<0.001
>1cm	4 (8.3)	0 (0)	0 (0)	114 (63)	40 (74.1)	29 (100)	4 (100)	
n (%)	Dysplasia Type							
	High-Grade Dysplasia		Low-Grade Dysplasia		None			p
<1cm	0 (0)		0 (0)		188 (60.6)			<0.001
>1cm*	28 (100)		37 (100)		122 (39.4)			

*Hyperplastic Adenoma (HPA), Inflammatory Polyp (INF), Tubular Adenoma (TA), Tubulovillous Adenoma (TVA), Villous Adenoma (VA), Carcinoma (CA)

Table 4. Histopathological Classification of the Polyps

Histopathological Findings	n(%)	M/F	Mean age years
Tubular Adenoma (TA)	181 (47.8)	106/75	53.5
Tubulovillous Adenoma (TVA)	54 (14.2)	35/19	50
Hyperplastic Adenoma (HPA)	48 (12.7)	27/21	53.1
Mucosa	33 (8.7)	22/11	52.2
Inflammatory Polyp (INF)	30 (7.9)	20/10	54.2
Villous Adenoma (VA)	29 (7.7)	16/13	52.6
Carcinoma (CA)	4 (1.1)	1/3	61
Total	379 (100.0)	227/152	53.8

Figure 1. The Location of the Polyps by Age

14% and 13% in patients with rectal bleeding, patients with abdominal pain and those with IBC symptoms, who underwent screening, respectively. This difference was not statistically significant (Table 1).

The most common sites of polyp localization were the rectosigmoid region (183 patients, (48.3%)) and the descending colon (66 patients, (17.4%)) (Figure 1). 239 patients had a single polyp (63 %) while 140 were detected to have multiple polyps (37%). There were 207 (54.6%) pedunculated polyps, 107 (28.2%) sessile and 65 flat polyps (17.2%). There was a statistical difference between the histopathological diagnosis and dysplasia by endoscopic appearance of the polyps (p<0.001). Inflammatory adenomas were only observed in flat polyps. No dysplasia was detected in the flat polyps. In contrast, the group pedunculated polyps were observed to involve dysplasia at the highest rate and accordingly, precancerous adenomas and carcinomas were detected at a higher rate (Table 2). Carcinoma was detected in a total of 4 patients (1.1%), which were all in the group of

pedunculated polyps. 188 (49.6%) polyps were smaller than 1 cm while 191 polyps were (50.4%) larger than 1 cm. Polyps larger than 1 cm were mostly detected to be villous adenomas and the difference was statistically significant. Similarly, the rate of dysplasia was also observed to be significantly high in polyps larger than 1 cm (Table 3). All the cases of carcinoma were detected in polyps larger than 1 cm. There were 3 female and 1 male case of cancer. The mean age was 59 years (54-61). Two were located in the rectosigmoid colon while the other was located in the descending colon.

While tubular adenoma was the most common pathological type, occurring in 181 patients (47.8%), tubulovillous adenoma (14.2%) and hyperplastic polyp (12.7%) followed, occurring in 54 and 48 patients respectively (Table 4). 313 patients (82.6%) didn't have dysplasia while 37 patients (9.7%) had low-grade dysplasia, 27 patients (7.1%) had high-grade dysplasia and

Table 5. The Relationship between the Pathological Type of the Polyps and Dysplasia

	High-Grade Dysplasia	Low-Grade Dysplasia	None	p
Hyperplastic Adenoma	0 (0)	0 (0)	48 (15.5)	<0.001
Inflammatory Polyp	0 (0)	0 (0)	30 (9.7)	
Mucosa	0 (0)	0 (0)	33 (10.6)	
Tubular Adenoma	1 (3.7)	2 (5.7)	175 (56.5)	
Tubulovillous Adenoma	25 (92.6)	5 (14.3)	24 (7.7)	
Villous Adenoma	1 (3.7)	28 (80)	0 (0)	

4 patients had cancer (1.1%) (Table 5). Among 62 patients with dysplasia (16.3%), the rates of high-grade and low-grade dysplasia were 43.5% and 56.5% respectively.

Discussion

The incidence of adenomatous polyps increases in direct proportion to the age and the mean age is reported to be 43-61 years in the literature (Altinparmak et al., 2001). In a trial by Wang et al. (2014), the 45-60 age group represented the period where the polyps occurred most frequently. In our cases, the rate of polyps was 63.6% within the age range of 40 and 59. While the number seems to be decreasing, this reduction may be explained by the number of presentations to the hospital, the length of the life span and the small number of patients undergoing colonoscopy at advanced age. The male gender is considered a risk factor for adenomatous polyps and the literature reports a rate of 53-59% for males and 40-46% for females (Lieberman et al., 2008; Diamond et al., 2011). Among our cases, the rate of males was higher than the females and this result was consistent with the literature.

In their trial, Alaties et al. (2014) most commonly reported patients with rectal bleeding (49.3%) and less commonly the patients in the screening group (19.4%) with chronic diarrhea, abdominal pain and intra-abdominal mass. No difference was observed with respect to the distribution of indications. In a study by Solakoglu et al. (2014), chronic constipation (50%) was the most common complaint followed by rectal bleeding (13%) and abdominal pain (10%). In our trial, rectal bleeding (36.1%) was the most common complaint followed by abdominal pain, IBS symptoms and the screening patients. The incidence of indications may vary between different patient populations and endoscopy clinics. What's important is to predict the potential location of the polyp and determine the diagnostic priority with respect to dysplastic transformation based on the symptoms. In this respect, while rectal bleeding is predominant in case of rectosigmoid polyps, patients with polyps in the other sites of the colon had commonly abdominal pain. Irrespective of the histopathology, the fact that a majority of the dysplasia cases occur in patients with rectal bleeding indicates the significance of colonoscopy in patients presenting with these complaints.

Colorectal polyps are most commonly located in the rectosigmoid region and exhibit a decreasing incidence towards the cecum (Pendergrass et al., 2008). In their study in a series of 914 cases, Eminler et al. (2011) reported that the adenomas were localized in the rectosigmoid region at a rate of 47. In a trial by Dolek et al. (2013),

the polyps were reported to be located in the rectum and sigmoid colon at a rate of 36.2% and 10.3% respectively; so rectosigmoid site was the most commonly involved site. Similarly, Delavari et al. (2014) also detected the colon polyps most commonly in the sigmoid colon (26.8%) and rectum (19.0%). In our study, a vast majority of the polyps were located in the rectogismoid colon (48.3%) with a tendency of reduction towards the proximal.

Lowenfelds et al. (2011) reported that two thirds of the colorectal polys were solitary. Silva et al. (2014) reported that more than half of all the patient series (51%) were solitary. In our trial, this rate was consistent with the literature (63%).

Since colorectal polyps are considered as precursor lesions of malignancy, early diagnosis and excision upon detection is of importance for early diagnosis of cancer. Classified by histopathological type, most are adenomatous polyps. These are also divided into subtypes by their incidence as follows: tubular adenomas (8-80%), tubuluovillous adenomas (8-16%) and villous adenomas (3-16%) (O'Brien et al., 1990; Bond, 2000). The most common group of polyps after the adenomatous polyps is the hyperplastic polyps. While they are accepted to be neoplastic, 13% of these polyps may have adenomatous transformation properties; and even if rarely, these polyps may have a dysplasia and carcinoma focus (Snover et al., 2005). In a trial by Dolek et al. (2013), involving 233 patients, the rates of tubular adenoma, hyperplastic polyp, tubulovillous adenoma and inflammatory polyps were detected as 59.8%, 23.2%, 9.2% and 6.3%, respectively among the colon polyps. In the trial by Delavari et al. (2014), similarly, the most common polyp type was the tubular adenoma (62.3%), followed by hyperplastic polyps (17%) and tubulovillous adenomas (10.3%) respectively. In our trial, in line with the literature, tubular adenomas were the most common type (47.8%); differently, tubulovillous adenomas (14.2%) were more common than the hyperplastic polyps (12.7%).

The importance of the adenomas lies in the fact that colorectal cancers originate from these polyps; however malignant transformation occurs in only 5% of the adenomas. This transformation process lasts between 7 and 10 years. Particularly, the rate of progression to malignancy is higher in adenomas with high-grade dysplasia (Jass et al., 1990). Since excision of adenomas with dysplasia would protect against cancer, the importance of the colonoscopy investigations in prophylactic medicine is further clarified (Ransohoff, 2009). In this respect, colon cancers have a particular place in the group of cancers that can be prevented by a simple intervention. In a trial by Alatise et al. (2014),

34.6% and 65.4% of 26 patients, in whom dysplasia was detected, were observed to have high-grade and low-grade dysplasia, respectively. In our study, we similarly detected a lower rate of high-grade dysplasia (43.5%) compared to low-grade dysplasia (56.5%), however the difference tended to disappear.

An increasing polyp size was associated with increased odds of adenoma, villous component, and dysplasia. Therefore, one may conclude that small (<1 cm) polyps should not be neglected (Silva et al., 2014). In their study, Solakoglu et al. (2014) observed that 73.6% of the polyps smaller than 1 cm were tubular adenomas while 50% of the polyps larger than 1 cm were villous adenomas. In a trial by Silva et al. (2014), the rate of middle-high grade dysplasia was 4.1% and 25.9% for polyps smaller and larger than 1 cm, respectively. In this study presented, the increasing polyp size was associated with an increased villous component and dysplasia. All of the cancer cases were detected again in polyps larger than 1 cm. only 8.3% of the polyps larger than 1 cm were non-neoplastic. While a larger number of trials report that dysplasia and cancer development are independent of the size, we failed to reach such a conclusion in this trial. Considering the localization, large-diameter adenomas were reported to be more common in the rectosigmoid colon (Williams et al., 1982). As a result, many polyps of malignancy potential may be detected, even with a simple examination.

This study supports the previous literature data in many respects. Differently, the higher rate of neoplastic adenomas and high-grade dysplasia may be attributed to the socio-economic-cultural difference. We also observed a close relationship between the polyp size and malignancy potential and may conclude that the increase in the polyp size could increase malignancy.

In conclusion, due to the fact that large-diameter polyps of malignancy potential are commonly located in the left colon and have a high prevalence among the middle-aged individuals, it would be appropriate to screen this population at regular intervals via rectosigmoidoscopy.

References

Alatise OI, Arigbabu AO, Agbakwuru AE, et al (2014). Polyp prevalence at colonoscopy among Nigerians: A prospective observational study. *Niger J Clin Pract*, **17**, 756-62.

Altınparmak E, Sezgin O, Parlak E, Altıntaş E (2001). Colorectal polyps 'The Yüksek İhtisas experience'. *Turk J Gastroenterol*, **12**, 49-52.

Anwar S, White J, Hall C, et al (1999). Sporadic colorectal polyps: management options and guidelines. *Scand J Gastroenterol*, **34**, 4-11.

Bond JH (2000). Polyp guideline: Diagnosis, treatment, and surveillance for patients with colorectal polyps. practice parameters committee of the American college of gastroenterology. *Am J Gastroenterol*, **95**, 3053-63.

Delavari A, Mardan F, Salimzadeh H, et al (2014). Characteristics of colorectal polyps and cancer; a retrospective review of colonoscopy data in Iran. *Middle East J Dig Dis*, **6**, 144-50.

Diamond SJ, Enestvedt BK, Jiang Z, et al (2011). Adenoma detection rate increases with each decade of life after 50 years of age. *Gastrointest Endosc*, **74**, 135-40.

Dolek Y, Karabulut YY, Topal F, Kursun N (2013). Evaluation of gastrointestinal polyps according to their size, localization and histopathologic types. *Endoscopy Gastrointestinal*, **21**, 31-5.

Eminler AT, Sakallı M, Irak K, et al (2011). Gastroenteroloji ünitemizdeki kolonoskopik polipektomi sonuclarımız. *Akademik Gastroenteroloji Dergisi*, **10**, 112-5.

Hodadoostan MK, Reza F, Elham M, et al (2010). Clinical and pathology characteristics of colorectal polyps in Iranian population. *Asian Pac J Cancer Prev*, **11**, 557-60.

Iravani S, Kashfi SM, Azimzadeh P, Lashkari MH (2014). Prevalence and characteristics of colorectal polyps in symptomatic and asymptomatic Iranian patients undergoing colonoscopy from 2009-2013. *Asian Pac J Cancer Prev*, **15**, 9933-7.

Itzkowitz SH, Potack J (2006). Colonic polyps and polyposis syndromes. In 'Sleisenger and Fordtran's Gastrointestinal and Liver Disease', Eds Feldman M, Friedman LS and Brandt LJ. Elsevier Health Sciences Press, Philedephlia pp 2713-36.

Jass JR, Sobin LH, Watanabe H (1990). World Health Organization's histological typing of intestinal tumours. A commentary on the second edition. *Cancer*, **66**, 2162-7.

Karaman H, Karaman A, Erden A, et al (2013). Relationship between colonic polyp type and the neutrophil/ lymphocyte ratio as a biomarker. *Asian Pac J Cancer Prev*, **14**, 3159-61.

Li M, Ali SM, Umm-a-OmarahGilani S, et al (2014). Kudo's pit pattern classification for colorectal neoplasms: a meta-analysis. *World J Gastroenterol*, **20**, 12649-56.

Lieberman DA, Holub JL, Moravec MD, et al (2008). Prevalence of colon polyps detected by colonoscopy screening in asymptomatic black and white patients. *JAMA*, **300**, 1417-22.

Lowenfels AB, Williams JL, Holub JL, Maisonneuve P, Lieberman DA (2011). Determinants of polyp size in patients undergoing screening colonoscopy. *BMC Gastroenterol*, 11, 101.

O'Brien MJ, Winaver SJ, Zauber AG, et al (1990). The National Polyp Study: Patient and polyp characteristics associated with high-grade dysplasia in colorectal adenomas. *Gastroenterolgy*, **98**, 371-9.

Pendergrass CJ, Edelstein DL, Hylind LM, et al (2008). Occurrence of colorectal adenomas in younger adults: an epidemiologic necropsy study. *Clin Gastroenterol Hepatol*, **6**, 1011-5.

Ransohoff DF (2009). How much does colonoscopy reduce colon cancer mortality? *Ann Intern Med*, **150**, 50 2.

Shussman N, Wexner SD (2014). Colorectal polyps and polyposis syndromes. *Gastroenterol Rep (Oxf)*, **2**, 1-15.

Silva SM, Rosa VF, Santos AC, et al (2014). Influence of patient age and colorectal polyp size on histopathology findings. *Arq Brass Cir Dig*, **27**, 109-13.

Snover DC, Jass JR, Fenoglio-Preiser C, Batts KP (2005). Serrated polyps of the large intestine: a morphologic and molecular review of an evolving concept. *Am J Clin Pathol*, **124**, 380-91.

Solakoglu T, Atalay R, Koseoglu H, et al (2014). Analysis of 2222 colorectal polyps in 896 patients: A tertiary referral hospital study. *Turk J Gastroenterol*, **25**, 175-9.

Wang FW, Hsu PI, Chuang HY, et al (2014). Prevalence and risk factors of asymptomatic colorectal polyps in Taiwan. *Gastroenterol Res Pract*, **2014**, 985205.

Williams AR, Balasooriya BA, Day DW (1982). Polyps and cancer of the large bowel: a necropsy study in Liverpool. *Gut*, **23**, 835-42.

Winawer SJ, Zauber AG, Fletcher RH, et al (2006). Guidelines for colonoscopy surveillance after polypectomy: a consensus update by the US multi-society task force on colorectal cancer and the American cancer society. *Gastroenterology*, **130**, 1872-85.