ANNALS OF SURGERY

Vol. 190 December 1979 No. 6

Morphology, Anatomic Distribution and Cancer Potential of Colonic Polyps

An Analysis of 7,000 Polyps Endoscopically Removed

HIROMI SHINYA, M.D., WILLIAM I. WOLFF, M.D.

From the Beth Israel Medical Center and the Mt. Sinai School of Medicine, New York, New York

The concept of a polyp–cancer sequence is assuming increasing credibility as a factor in the development of colorectal cancer. Colonoscopy permits most colonic polyps to be endoscopically removed and studied pathologically. Of various polyp types encountered in the colon only neoplastic polyps are regarded as having malignant potential. Neoplastic polyps include tubular adenomas (formerly, adenomatous polyps), villous adenomas and villotubular adenomas (formerly, mixed or tuboglandular polyps). Cancerous changes must penetrate the muscularis mucosae for a polyp to be regarded as clinically malignant. The present report analyzes a series of 5,786 adenomas from over 7,000 polyp endoscopically removed. The largest number of each type of adenoma presented in the sigmoid colon, followed by the descending colon in terms of frequency. In all zones tubular adenomas were most common, villous least. Abnormal cellular change, from dysplasia to carcinoma *in situ* to invasive cancer was most frequently found in the sigmoid colon and, in all colon sectors, increased as the villous componency of the polyp increased. However, all categories of neoplastic polyps showed malignant changes. Polyp size, long recognized as a factor, was shown to be importantly related to malignant change, but invasive cancer was found even in polyps less than 1 cm in diameter. In addition, the incidence of malignancy rose parallel to the frequency of synchronous and metachronous polyps. A vigorous program for detection and endoscopic removal of colorectal polyps is recommended as a means of reducing the incidence of colorectal cancer.

Presented at the Centennial Meeting of the New York Surgical Society in Association with the Philadelphia Academy of Surgery, the Boston Surgical Society and the Baltimore Academy of Surgery, March 14, 1979.

Reprint requests: William I. Wolff, M.D., Chairman, Department of Surgery, Beth Israel Medical Center, New York, New York 10003.

Submitted for publication: April 27, 1979.

AN ENLARGING BODY of evidence supports the importance of the colonic polyp as a precursor to the development of colorectal cancer.[2,8,14] The concept of a polyp–cancer sequence hinges on an accurate analysis of the abnormal changes within colonic adenomas, and the frequency with which these changes occur. Of parallel interest is how these alterations relate to polyp morphology, polyp size and polyp development in different regions of the colon.

Most previous reports linking polyps to carcinoma have been based on lesions removed either at surgery or via proctosigmoidoscopy from the distal colorectum. With the introduction of colonoscopy of the entire bowel[10] and the endoscopic resection of colonic polyps,[12] a new era was entered into.

It is now possible to examine systematically the entire colon of large numbers of individuals with

TABLE 1. *Colorectal Polyps*

Nonneoplastic
juvenile polyp = retention polyp
hyperplastic polyp = metaplastic polyp
Neoplastic
tubular adenoma = adenomatous polyp
villous adenoma = papillary polyp
villotubular adenoma = villoglandular polyp
polypoid carcinoma = malignant polyp

0003-4932/79/1200/0679 $00.75

TABLE 2. *Distribution of Types of Adenomas in Large Intestine*

Region of Large Bowel	Tubular		Villotubular		Villous	
	No.	%	No.	%	No.	%
Rectum	171	(5)	86	(6)	72	(14)
Sigmoid	1771	(48)	720	(47)	188	(36)
Descending	877	(24)	398	(26)	132	(25)
Transverse	436	(12)	146	(10)	37	(7)
Rt. colon	470	(11)	192	(11)	90	(18)
Total	3725	(100)	1542	(100)	519	(100)

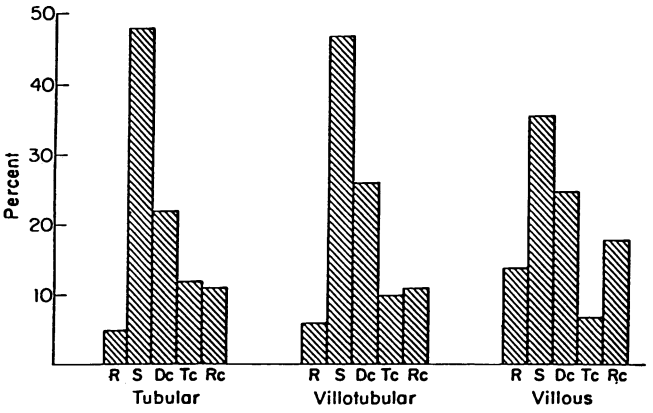

FIG. 1. Distribution of types of adenomas in large intestine. R.: rectum; S: sigmoid; Dc: descending colon; Tc: transverse colon; Rc: right colon.

symptomatic and asymptomatic lesions at various stages of development.

With endoscopic electrosurgical polypectomy, initiated by us in 1969,[11] it became possible to remove polypoid lesions endoscopically and to document the presence or absence of cancer in a polyp in almost any location within the large bowel. Colonoscopic polypectomy is reliable, accurate and safe, and is now practiced on an international scale. During the past ten years approximately 7,000 colonic polyps have been removed in our units via the colonoscope by the snare-cautery technique with no mortality and with an extremely low morbidity. The retrieved polyps were completely studied pathologically and classified according to histological type. 5,786 were adenomas.

Classification of Polyps and Adenomas

It is generally agreed that the bowel polyps which require attention from the clinician because of malignant potential are the neoplastic variety or adenomas. These have been classified as 1) adenomatous polyps, 2) villous adenomas and 3) mixed, or villoglandular polyps. The problems and confusions arising from imprecise and even-lapping terminology are legion and have been analyzed by ourselves[13] and others.[7] A new and more descriptive terminology now in use[14] is shown in Table 1.

As has been previously emphasized,[4,7,13] one must distinguish between superficial and invasive cancer, since this distinction has important clinical implications with respect to polyp management. All gradations of dysplasia can be recognized in the mucosa of neoplastic polyps to the stage of definite superficial cancer. If this focal cancer does not penetrate the muscularis mucosae, the lesion is labeled carcinoma *in situ*. Although a true cancer pathologically, *in situ* carcinoma is not regarded as malignant in a clinical sense because it has not been known to metastasize. When, however, cancerous cells are definitely seen to penetrate the muscularis mucosae in histologic sections, the finding is known as invasive cancer and the polyp is regarded as "malignant." This holds for both pedunculated and sessile polyps. In order to determine accurately the presence and degree of penetration or invasion, the polyp must be completely excised and multiple fixed tissue sections with proper orientation must be prepared.

If more than 75% of a given polyp has a tubular configuration, our pathologists, arbitrarily, designate the lesion as a tubular adenoma. Such lesions are usually pedunculated if over 0.5 cm in size. Ulceration in the head of such a pedunculated polyp almost invariably signifies invasive cancer.

Polyps with mixed configuration, formerly known as villoglandular are now termed villotubular adeno-

TABLE 3. *Neoplastic (Adenomatous) Polyps Premalignant and Malignant Change According to Location*

Region of Large Bowel	Total No.	Benign		Dysplasia		Cancer-In-Situ		Inv. Cancer	
		No.	%	No.	%	No.	%	No.	%
Rectum	329	226	(5)	18	(3)	65	(9)	20	(7)
Sigmoid	2679	1933	(45)	226	(43)	356	(50)	164	(58)
Descending	1407	1086	(26)	110	(21)	165	(23)	46	(16)
Transverse	619	431	(10)	97	(18)	62	(8.5)	29	(10)
Rt. colon	752	581	(14)	79	(15)	68	(9.5)	24	(9)
Total	5786	4257	(100)	530	(100)	716	(100)	283	(100)

TABLE 4. *Relative Frequencies of Pathologic Stages in Adenomas*

Adenomas	Benign		Dysplasia		Cancer In-Situ		Inv. Cancer		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Tubular	2863	(77)	296	(8)	462	(12)	104	(3)	3725	(100)
Villotubular	1075	(70)	162	(11)	175	(11)	130	(8)	1542	(100)
Villous	319	(61)	72	(14)	79	(15)	49	(10)	519	(100)
Total	4257		530		716		283		5786	

mas. This intermediate group of polyps containing microscopically, areas both of tubular and of villous pattern, is one which has come to be recognized as a separate category over only the past two decades. Since mixed features are quite common in neoplastic polyps, an arbitrary figure of at least 25% for one component must be met before a polyp is placed in this subdivision by our pathologists (other pathologists may utilize different percentages).

Villous polyps are frequently multilobulated and are those polyps having greater than a 75% villous morphology. They constitute the least common form of neoplastic polyp and are, more often than are the others, sessile in configuration. They have long been recognized as having the highest tendency toward malignant change. Because they tend to be larger when discovered and also sessile, villous adenomas often have to be removed in piece-meal fashion via the endoscope. Some are better removed surgically.

Distribution

The anatomical location of occurrence for each type of polyp was tabulated (Table 2). The largest number of each form of adenoma occurred in the sigmoid colon, followed by the descending colon in frequency. But, in all zones, the highest percentage of adenomas is tubular, followed in diminishing order by villotubular and villous. Our figures differ in a number of respects from those appearing in the literature and, in assessing the dissimilarities, one must be cognizant of variations in acquiring and sorting the material presented. Thus, one must consider whether the studies are based on surgical or autopsy specimens, whether or not hyperplastic polyps are distinguished from the neoplastic (adenomatous) forms, the age of the patient population and other important factors.

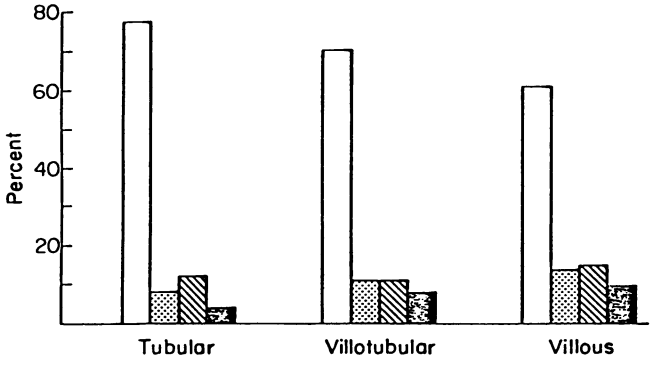

FIG. 2. Relative frequencies of pathologic stages in adenoma types. Open bars: benign; dotted bars dysplasia; Striped bars: cancer *in situ*; solid black bars: invasive carcinoma.

This table is important in a number of ways: it is, by far, the largest series reported to date from a single institution. It analyzes neoplastic polyps only and these by category (vide supra). Only the series by Grinnell and Lane[5] is comparable. It lays to rest the concept that villous adenomas are unusual[8,9] above the rectosigmoid level. Figure 1 illustrates this point well.

Accounting for the relatively low incidence of rectal polyps is the fact that polyps at a low level are usually readily managed via the proctosigmoidoscope and, thus, are not referred for colonoscopy.

Table 3 analyzes the presence of premalignant or malignant change in this group of adenomatous polyps according to their anatomical location. It is seen that in each region most polyps are benign and that the highest incidence of dysplasia, carcinoma *in situ*, and invasive carcinoma occurs in the sigmoid colon, followed by the descending colon. Again, the selective nature of the material, with a paucity of cases within range of the conventional sigmoidoscope, must be noted.

Table 4 breaks down the occurrence of premalignant and malignant changes according to the category of

TABLE 5. *Size of Adenoma Related to Cancer In-Situ*

Size of Adenoma (cm)	Tubular		Villotubular		Villous	
	No.	CIS %	No.	CIS %	No.	CIS %
0.5–0.9	1489	77 (5.1)	132	5 (3.8)	40	3 (7.5)
1.0–1.9	1713	264 (15.4)	776	62 (8.0)	249	19 (7.6)
2.0–2.9	432	96 (22.2)	475	74 (15.6)	100	14 (14.0)
3.0–	91	25 (27.5)	159	34 (21.4)	130	43 (33.0)
Total	3725	462 (12.4)	1542	175 (11.3)	519	79 (15.2)

TABLE 6. *Size of Adenoma Related to Invasive Carcinoma*

Size of Adenoma (cm)	Tubular		Villotubular		Villous	
	No.	No. of Inv. Ca (%)	No.	No. of Inv. Ca (%)	No.	No. of Inv. Ca (%)
0.5–0.9	1489	5 (0.3)	132	2 (1.5)	40	1 (2.5)
1.0–1.9	1713	61 (3.6)	776	50 (6.4)	249	14 (5.7)
2.0–2.9	432	28 (6.5)	475	54 (11.4)	100	17 (17.0)
3.0–	91	10 (11.0)	159	24 (15.0)	130	17 (13.1)
Total	3725	104 (2.8)	1542	130 (8.4)	519	49 (9.5)

polyp. The high incidence of premalignant and malignant change in villous adenomas has long been recognized. The lower incidence in tubular and villotubular adenomas confirms our previous reports on the subject. However, the much higher overall frequency of these types of adenomas makes even a low incidence of malignancy significant. The findings answer partly the question posed by Morson and Dawson,[7] "The real problem is not whether adenomas are premalignant, but whether all adenomas are premalignant, and if not all, which adenomas are premalignant" (Fig. 2).

Premalignancy, Malignancy and Polyp Size

The advancing incidence of malignancy with increasing polyp size has long been recognized.[2,3,5,7] Tables 5 and 6 show the frequency of carcinoma *in situ* and of invasive cancer respectively by polyp type and polyp size. The figures support the higher incidence of malignant change in polyps with a large villous complement, but they also confirm Enterline's contention that "the increased malignant potential observed is more a function of size."[2]

Of equal interest, and relevant to the precolonoscopy era when radiologically demonstrated (or missed) polyps one cm in diameter or under, were regarded

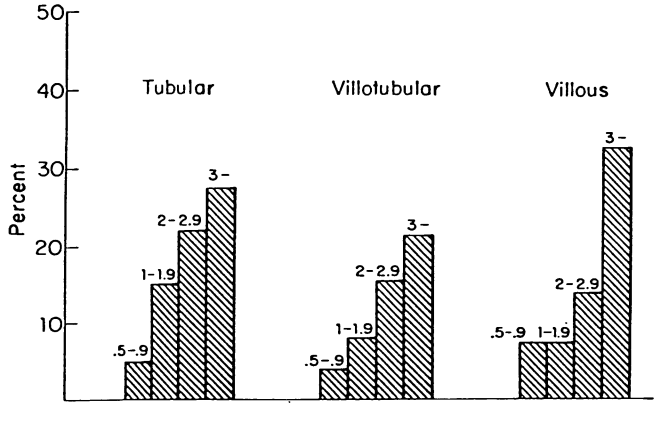

FIG. 3. Size of adenoma related to carcinoma *in situ*.

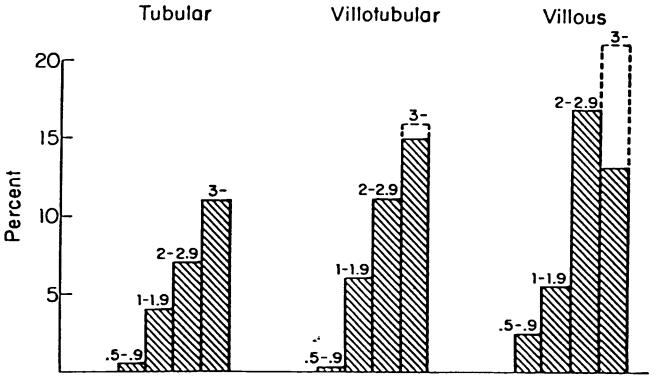

FIG. 4. Size of adenoma related to invasive carcinoma.

as insignificant, is the fact that both carcinoma *in situ* (Fig. 3) and invasive cancer (Fig. 4) can and do occur in polyps of all three forms in this size range.

Some of the larger villous and villotubular adenomas had to be removed surgically rather than endoscopically and this increment is shown by the dotted lines (Fig. 4).

Synchronous and Metachronous Adenomas

The frequency of multiple tumors of the colon is recognized. Bussey,[1] reporting the St. Mark's Hospital experience, found synchronous multiple tumors, benign or malignant, in 19.7% among 3,002 patients surveyed and a 6% incidence of metachronous tumors in addition. He suggests that the incidence would have been even higher had not colonoscopy been unavailable over most of the time span covered.

Table 7 shows our experience with patients who had more than one adenoma either synchronously or metachronously. It indeed bears out Bussey's contention. Moreover, one is impressed with the rising occurrence of carcinoma *in situ* and invasive carcinoma as the number of neoplastic polyps rises. This correla-

TABLE 7. *Number of Synchronous and Metachronous Adenomas Per Patient and Invasive Ca*

No. of Adenomas	No. of Patients	Cancer In-Situ		Invasive Ca	
		No.	%	No.	%
1	1160	161	(13.8)	95	(8.2)
2	342	73	(21.3)	34	(10.0)
3	162	47	(29.0)	27	(16.6)
4	59	28	(47.4)	7	(11.9)
5	43	12	(27.9)	6	(14.0)
6	14	10	(71.4)	4	(28.6)
7	11	7	(63.6)	0	
8	6	8	(133.3)	1	(16.7)
9	6	2	(33.3)	3	(50.0)
10–24	8	5	(62.5)	3	(37.5)
25–50	2	8	(400.0)	2	(100.0)
	1813	361	(20.0)	182	(10.0)

tion is another strong finding supporting the polyp–cancer sequence.

Discussion and Conclusions

We present our experience with over 7,000 endoscopically removed polyps of the colon and rectum, analyzing in detail 5,786 neoplastic (adenomatous) polyps. These are divided into tubular adenomas, villotubular adenomas and villous adenomas. There is strong supportive evidence for a polyp–cancer sequence. Premalignant and malignant changes are defined and correlated with polyp location anatomically, with polyp size and with the proportion of villous componency.

Since the incidence of carcinoma of the colon is on the rise and since burgeoning evidence supports a polyp–cancer sequence, we suggest that a vigorous program for endoscopic detection and excision of colorectal polyps will favorably influence the management of this disease.

References

1. Bussey, H. J. R.: Multiple Adenomas and Carcinomas *In* Morson, B. C. (Ed.) The Pathogenesis of Colorectal Cancer. Philadelphia, W. B. Saunders & Co., 1978.
2. Enterline, H. T.: Polyps and Cancer of the Large Bowel *In* Morson, B. C. (Ed.) Pathology of the Gastrointestinal tract, Current Topics in Pathology 63, Berline, Springer-Verlag, 1976.
3. Enterline, H. T., Evans, G. N., Merrado-Lugo, R., et al.: Malignant Potential of Adenomas of Colon and Rectum. JAMA, 179:322, 1962.
4. Fenoglio, C. M. and Lane, N.: The Anatomic Precursor of Colorectal Cancer. Cancer, 34:819, 1974.
5. Grinnell, R. J. and Lane, N.: Benign and Malignant Adenomas Polyps and Papillary Adenomas of the Colon and Rectum: An Analysis of 1,856 tumors in 1,335 patients. Internat. Abstr. Surg., 106:519, 1958.
6. Morson, B. C.: The Pathogenesis of Colorectal Cancer. Major Problems in Pathology Vol. 10, Philadelphia, W. B. Saunders Co., 1978.
7. Morson, B. C. and Dawson, I. M. P.: Gastrointestinal Pathology, Oxford, Blackwell Scientific Publications, 1972.
8. Olsen, R. O. and Davis, W. C.: Villous Adenomas of the Colon Benign or Malignant? Arch Surg., 98:487, 1969.
9. Spratt, J. S., Ackerman, L. V. and Mayer, C. A.: Relationship of Polyps of the Colon to Colonic Cancer. Ann. Surg., 148: 682, 1958.
10. Wolff, W. I. and Shinya, H.: Colonfiberoscopy, JAMA, 217: 1509, 1971.
11. Wolff, W. I. and Shinya, H.: Polypectomy via the Fiberoptic Colonoscope: Removal of Neoplasms beyond reach of the Sigmoidoscope. N. Engl. J. Med., 288:329, 1973.
12. Wolff, W. I. and Shinya, H.: A New Approach to the Management of Colonic Polyps. *In* Hardy, J. D. and Zollinger, R. M. (Ed.) Advances in Surgery, Vol. 7, Chicago, Year Book Medical Publishers, Inc. 1973.
13. Wolff, W. I. and Shinya, H.: Definite Treatment of "Malignant" Polyps of the Colon. Ann Surg., 182:516, 1975.
14. Wolff, W. I. and Shinya, H.: The Impact of Colonoscopy on the Problem of Colorectal Cancer. *In* Ariel, I. M. (Ed.): Progress in Clinical Cancer Vol. VII, New York, Grune & Stratton, 1978.