Optical Biopsy System Distinguishing between Hyperplastic and Adenomatous Polyps in the Colon during Colonoscopy

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Abstract. *Background: It has been established that the removal of adenomatous colon polyps drastically reduces the incidence of colorectal cancer (CRC), but polypectomy is not without risk. The aim was to determine the correlation between the results of an optical biopsy system and the histopathology report of the physical biopsy specimens of the same polyps removed at colonoscopy. Patients and Methods: Paired optical and physical biopsies were performed on 55 polyps with complete polypectomy of the same tissue. Results: Fifty-three adenomatous polyps and two hyperplastic polyps were identified by the hospital pathologist. The optical biopsy system identified 52 polyps as suspect (adenomatous) and 2 as non-suspect (hyperplastic). One villous adenoma could not be optically analyzed due to friability. Conclusion: The WavSTAT® Optical Biopsy System provides accurate information to the gastroenterologist to assist in distinguishing between hyperplastic and adenomatous polyps. It is safe for the patient and does not unduly increase the time required for an endoscopic examination.*

In the 1980's and 1990's Europe saw a widespread increase in the incidence of colorectal cancer (CRC) along with the general aging of the population as a whole. In 2004 there were 375,000 cases diagnosed and 203,000 deaths from this disease, making it Europe's second most common cancer diagnosed and second most common cause of death from cancer following lung cancer (1). CRC is the third most common cancer and the third leading cause of cancer death in the United States. The prevalence of adenomatous polyps of the colon and rectum is high in both the United States and other Western Countries. It is widely accepted that adenomatous polyps of the large intestine are precursors to CRC. Screening colonoscopy for the detection and removal of these polyps has positively impacted the death rate of patients worldwide and the National Polyp Study conducted in the United States demonstrated a reduction in the incidence of CRC by 76%-90% following polypectomy (2). In Europe and Japan CRC screening is being increased with the aim of further decreasing the incidence and mortality of this disease (3). New and improved imaging and diagnostic technologies are being introduced to help locate precursor lesions at the earliest stage possible.

There are two types of polyps found in the colon and rectum. Most CRC arise from preexisting adenomas (4) and the removal of these adenomatous polyps reduces the risk of future CRC (5). However, macroscopic differentiation between a hyperplastic polyp and an adenoma during colonoscopy is extremely difficult, so a biopsy or polypectomy is generally used for the histological verification of polyps of the large intestine. There is some inherent risk to the current colonoscopy/polypectomy procedure. The incidence of bleeding during or after polypectomy is reported at 0.3-6.1% with higher bleeding rates (up to 22.1%) for larger polyps. Perforation from therapeutic colonoscopy is reported at 0.08-2.2% (6). Also important is the substantial "miss rate" for colon polyps. It would therefore be advantageous clinically to be able to identify adenomas and leave hyperplastic polyps with no malignancy potential *in situ* (7-8). The value of a device that could distinguish between hyperplastic and adenomatous tissue *in vivo* is obvious.

The study objective was to gain experience in examining polyps of the large intestine using an optical biopsy system and to compare those results with the physical histological report.

Patients and Methods

This prospective study was conducted at the Second Internal Clinic, Thomayer's Teaching Hospital, Prague, Czech Republic. Patients who were referred for endoscopy and provided informed consent were enrolled in the study between October 2007 and April 2008.

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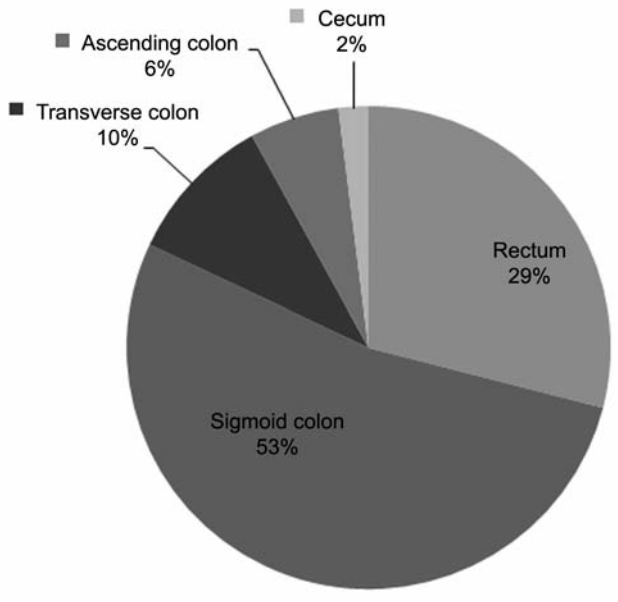

Figure 1. *Polyps distribution.*

A total of 53 patients were enrolled and all underwent colonoscopic examination and completed the study. Out of these, 33 were male and 20 were female with ages ranging from 30-82 years with a mean age of 62 years. Inclusion criteria were average risk for colon cancer and ability to provide consent. The exclusion criteria were poor general physical condition, use of anticoagulants which would preclude removal of polyps during colonoscopy and acute co-morbidity.

The polyps ranged in size from 5 mm to 30 mm, mostly being 5-9 mm, and were distributed throughout the large intestine. Most of the polyps were found in the region of the sigmoid colon (Figure 1).

The patients were given a pancolonoscopic examination using first an optical biopsy of the polyp followed by a physical biopsy and removal of the polyp. The optical biopsies were first visualized on the screen of a WavSTAT® Optical Biopsy System (SpectraScience, Inc., San Diego, CA, USA) as either green (non-suspect) or red (suspect) then noted on the patient's chart so they could later be correlated to the histology reports. In all cases, the physical biopsies were performed at the same point on the polyp as the optical biopsies using the same optical forceps.

The colonoscopic examination was conducted using a CFQ-180 colonoscope manufactured by Olympus Corporation, Tokyo, Japan. The WavSTAT® Optical Biopsy System used for the optical biopsies uses laser induced autofluroescence to obtain an objective, *in vivo* analysis of polyps of the large intestine. The principle behind this method is a low-intensity/non-damaging laser light which is directed from the console through an optical fiber mounted in modified biopsy forceps. These biopsy probes are directed through the working channel of the colonoscope and brought into direct contact with the actual polyp. Upon contact with the optical fiber and foot pedal activation, the tissue absorbs laser light resulting in the excitation of the tissue being examined. The resulting autofluorescent signal is sent back and analyzed by a proprietary algorithm in the system console. Within seconds a green "non-suspect" or red "suspect" result is displayed on the console's screen. An advantage of this system is that a physical biopsy sample can be taken using the same forceps from the exact place where the optical biopsy is performed (9).

Table I. *Morphology of polyps.*

Polyp	Optical biopsy	Histology of biopsy	Histology of removal polyp
Hyperplatic	2	2	2
Adenoma	52	52	52
Total			54

All colonoscopies were performed by a single endoscopist with 15 years of experience. The patients were seen in the endoscopy clinic after undergoing standard colonic preparation to ensure the lumen of the colon was completely clean and that the surface of the polyp was free of residual stool and debris. Any residue on the mucosa of the polyp was removed using pressurized water through a spray catheter to ensure the mucosa of the polyp did not bleed. All the patients were sedated using Midazolam 2.5 mg intravenously.

Results

A total of 55 polyps were identified in the 53 patients; 2 hyperplastic polyps and 53 adenomas. It was not possible to perform the optical biopsy on one polyp measuring 12 mm located in the sigmoid colon. The mucosa of this polyp was very friable and histopathology determined it was a villous adenoma. Thus in the histopathological analysis overall 53 polyps were found to be adenomatous and 2 hyperplastic. The optical biopsy system correctly recognized the 52 adenomas and the 2 hyperplastic polyps giving 100% correlation between the optical biopsy results and the histological results (Table I). In the one case, where the optical biopsy was indeterminate, this measurement was excluded from further analysis of specifity and sensitivity. Therefore the specifity and sensitivity of the optical biopsy method was 100% (no adenoma or hyperplastic polyp was misidentified).

Discussion and Conclusion

Histopathological information about a polyp, before a polypectomy is performed, would be extremely helpful in deciding what sort of therapeutic intervention to perform; such as the decision of whether to perform a difficult, fragmented polypectomy on a large hyperplastic polyp. It is also important to consider whether a polypectomy should be performed on a hyperplastic polyp in an elderly patient who

has serious comorbidity or one who is taking anticoagulants. Polypectomy associated with diverticulosis is not necessarily a simple procedure. In all these cases, it would be extremely useful to know the histological structure of the polyp before a polypectomy is performed, thereby decreasing the risk to the patient.

In this our first experience using the WavSTAT® Optical Biopsy System there was excellent correlation between the optical biopsy and the histopathological examination. In one case, the optical biopsy was unable to show the nature of the polyp, as the mucosa of this polyp was very friable due to the villous nature of the tissue. Nevertheless, it seems that such optical biopsy could be of great benefit in the examination of polyps of the large intestine as well as for examinations performed to detect neoplastic changes in the area of inflammatory bowel disease. Optical biopsy is a very safe method which does not greatly increase the examination time and can provide the endoscopist with crucial information concerning the tissue during examination. This information can then be used when considering patient follow-up.

In order to further verify the excellent results achieved using the optical biopsy system for identification of adenomatous and hyperplastic polyps, we intend to continue using it to obtain a larger and thus statistically more significant data set. All indeterminate results and the circumstances in which these results are obtained will be tracked as part of the dataset.

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