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**Surveillance of colonic polyps: are we getting it right?**

Bonnington S *et al*. future of adenoma surveillance

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**Abstract**

Colorectal cancer (CRC) is the third most commonly diagnosed cancer worldwide. The identification of colonic polyps can reduce CRC mortality through earlier diagnosis of cancers and the removal of polyps: the precursor lesion of CRC. Following the finding and removal of colonic polyps at an initial colonoscopy, some patients are at an increased risk of developing CRC in the future. This is the rationale for post-polypectomy surveillance colonoscopy. However, not all individuals found to have colonic adenomas have a risk of CRC higher than that of the general population. This review examines the literature on post-polypectomy surveillance including current international clinical guidelines. The potential benefits of surveillance procedures must be weighed against the burden of colonoscopy: resource use, the potential for patient discomfort, and the risk of complications. Therefore surveillance colonoscopy is best utilised in a selected group of individuals at a high risk of developing cancer. Further study is needed into the specific factors conferring higher risk as well as the efficacy of surveillance in mitigating this risk. Such evidence will better inform clinicians and patients of the relative benefits of colonoscopic surveillance for the individual. In addition, the decision to continue with surveillance must be informed by the changing profile of risks and benefits of further procedures with the patient’s advancing age.

**Key words:** Adenoma; polyp; colonoscopy; surveillance; colorectal cancer

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**Core tip:** Increasing numbers of surveillance colonoscopies for previous colonic polyps are being performed. Each colonoscopy brings the burden of bowel preparation, potential discomfort, and risk of complications. Colonoscopy is a finite resource and must be recommended only with a strong indication. Individuals with non-advanced adenomas have no significantly increased risk of colorectal cancer (CRC) compared to the general population. Patients with an advanced adenoma, have a CRC risk similar to that of the general population after just one surveillance colonoscopy. This review examines the evidence behind current surveillance guidelines and questions the rationale for surveillance in individuals with relatively low cancer risk.

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**INTRODUCTION**

Colorectal cancer (CRC) is the second leading cause of death from cancer in the United Kingdom[[1](#_ENREF_1)] and United States[[2](#_ENREF_2)]. Over 41000 people in the United Kingdom are diagnosed with CRC annually and over 16000 people die of the disease.

Recognised risk factors for the development of CRC include advancing age, a personal or family history of CRC, longstanding inflammatory bowel disease affecting the colon, and specific conditions such as familial adenomatous polyposis (FAP), and hereditary non-polyposis colon cancer (HNPCC). This review focuses on an important risk factor for the development of CRC: a personal history of colorectal adenomas.

Some colonic polyps such as adenomatous and serrated polyps carry malignant potential, while others do not (hyperplastic, post-inflammatory, hamartomatous). This review will discuss only those polyps with malignant potential.

The majority of CRCs arise from colonic adenomas. Adenomas arise following aberrant proliferation of epithelial cells in the colon. These lesions may then progress to varying degrees in size and dysplasia[[3](#_ENREF_3" \o "Vogelstein, 1988 #33)]. Adenomas represent the major precursor for CRC both in high-risk groups such as patients with a family history of familial adenomatous polyposis (FAP) or hereditary non-polyposis colorectal cancer (HNPCC), as well as in the general population. This concept is termed the “adenoma-carcinoma sequence”[[4-8](#_ENREF_4" \o "Nowell, 1986 #28)].

However, 20%-30% of colorectal cancers arise through a different molecular pathway to the conventional adenoma-carcinoma sequence. These CIMP-positive cancers (CpG island methylator phenotype) are believed to arise from serrated polyps. Such lesions are over-represented among “interval cancers” (cancers diagnosed 6-36 mo after a colonoscopy)[[9](#_ENREF_9" \o "Leggett, 2010 #109)]. Growing evidence points to the importance of recognising and managing serrated lesions in preventing CRC[[10](#_ENREF_10)].

The speed of progression along the pathway of proliferation and dysplasia is a key factor in determining clinical practice in patients found to have colonic adenomas. Progression from adenoma to invasive cancer can occur in 5 years or take more than 20 years[[11](#_ENREF_11" \o "Loeve, 2004 #25)]. Additionally, progression along this pathway is highly variable: one study estimates that only 0.25% of adenomas per year will progress to cancer[[12](#_ENREF_12)]: some stabilise and some regress[[11](#_ENREF_11),[13-15](#_ENREF_13)].

Adenoma prevalence in Western screening populations (age 50–75 years) can be as high as 40%, with advancing age and male sex associated with higher prevalence. However, lifetime risk of CRC is only 5.5% due to the highly variable progression of adenomas[[16-22](#_ENREF_16" \o "Rex, 1991 #26)]. Overall, projections of 10-year cumulative risk for progression from adenoma to carcinoma are less than 10%[[15](#_ENREF_15),[23](#_ENREF_23)].

**RISK FACTORS**

In recent years, an understanding of adenoma features predicting risk of progression to cancer has led to the term “advanced adenoma”[[15](#_ENREF_15)], referring to adenomas possessing at least one of three high risk characteristics: size of at least 10mm, villous architecture of at least 25%, or high grade dysplasia[[24-26](#_ENREF_24)]. Overall, these lesions progress to cancer at an annual rate of up to 5%: significantly higher than the average rate for all adenomas[[12](#_ENREF_12)], and this risk increases with age to 25% at age 55 years and to 40% at age 80 years. Annual rates of progression from adenoma to carcinoma also vary depending on which of these advanced features is present. Size of at least 10mm confers a 3% annual risk; villous architecture 17%, and high grade dysplasia 37%[[12](#_ENREF_12)].

As these figures illustrate, high grade dysplasia (HGD) confers high risk of progression to cancer. However, in keeping with the adenoma-carcinoma sequence described previously, high grade dysplasia is more likely to be found in larger lesions: as adenomas progress in size, so too dysplasia progresses[[27](#_ENREF_27" \o "Winawer, 1993 #41)]. The number of adenomas possessing advanced features (HGD or > 25% villous architecture) increases with polyp size from approximately 1%-2% in diminutive adenomas (< 5 mm) to 7%-12% for small adenomas (5 to 9 mm) and 20%-30% for large adenomas (≥ 10 mm)[[24](#_ENREF_24),[28](#_ENREF_28),[29](#_ENREF_29)]. Advancing age of the patient also increases the likelihood of HGD within an adenoma, independent of polyp size and histological type[[30](#_ENREF_30" \o "O'Brien, 1990 #118)].

Most adenomas detected at colonoscopy (60%-75%) are smaller than 10mm diameter[[31](#_ENREF_31)]. Larger adenomas of at least 10 mm in diameter are at higher risk of containing CRC and are also a risk factor for metachronous cancer development (*i.e.,* a cancer diagnosed at least 6 months after the index procedure)[[24](#_ENREF_24)]. The absolute risk of metachronous advanced adenomas is close to 20% in patients whose largest baseline adenoma is 20mm or more in size[[32](#_ENREF_32)].

The risk factor most closely correlating to CRC risk is the total number of adenomas, both at index procedure and cumulatively over the individual’s lifetime. Patients with one or two small tubular adenomas removed do not have a significantly increased metachronous colorectal cancer risk[[33](#_ENREF_33" \o "Lieberman, 2007 #50)]. In contrast, the presence of one or more advanced adenomas predicts a higher rate of both any and advanced metachronous adenomas[[25](#_ENREF_25)]. The risk of metachronous CRC increases with the number of advanced adenomas[[24](#_ENREF_24" \o "Winawer, 1993 #18)]. Large polyp size (≥ 10 mm) and proximal location in the colon are independent predictors of further advanced neoplasia at follow-up[[34](#_ENREF_34" \o "Martinez, 2001 #52)]. The risk for metachronous advanced adenomas increases progressively with the number of adenomas at baseline examination: patients with only 1 adenoma have a risk of 9% while those with 5 or more adenomas have a 24% risk.

**BENEFIT OF COLONOSCOPY**

Colonoscopic screening has been shown to be effective in reducing CRC incidence and mortality[[27](#_ENREF_27),[35-38](#_ENREF_35)].

This effect is via a number mechanisms. Firstly, the removal of pre-cancerous lesions, *i.e.,* adenomatous polyps, thereby interrupting the progression to carcinoma: preventing cancers. Secondly, detection of CRC at an earlier, pre-symptomatic stage with resultant increased likelihood of successful endoscopic or surgical treatment[[27](#_ENREF_27),[39-41](#_ENREF_39)].

The third mechanism, which may reduce CRC incidence and mortality, is surveillance colonoscopy. Risk stratification based upon index colonoscopy findings allows patients with polyps at higher risk of progression to cancer to be offered a further examination in the future[[19](#_ENREF_19),[20](#_ENREF_20),[42](#_ENREF_42)]. The evidence for the potential benefits of surveillance will be discussed in detail later.

Patients diagnosed with CRC at an earlier stage have significantly better prognosis than those diagnosed with more extensive disease. Of patients diagnosed with Dukes’ A CRC, 93% will survive 5 years. Those diagnosed with modified Dukes’ D cancer however, have a less than 7% chance of living a further 5 years.

Colonoscopy is considered to be the gold standard for adenoma detection and affords an opportunity for therapy, through polypectomy, as well as allowing histological diagnosis. Double-contrast barium enema and CT colonography (CTC) show poorer sensitivity compared to colonoscopy, particularly with respect to very small and flat polyps[[43](#_ENREF_43),[44](#_ENREF_44)]. An optimally performed double-contrast barium enema and FIT (faecal immunohistochemical test) detect only half of adenomas of 5mm or larger that are detected by colonoscopy[[45](#_ENREF_45" \o "Imperiale, 2014 #89)].

**LIMITATIONS OF COLONOSCOPY**

However, there remain limitations to colonoscopic screening. Even colonoscopy does not allow detection of all adenomas. “Back-to-back” colonoscopies have indicated significant miss rates of 27% for small adenomas (< 5 mm) and 6% for adenomas of more than 10 mm diameter[[46](#_ENREF_46)]. Studies performing both CTC and colonoscopy estimate that the colonoscopy miss rate for polyps over 10mm in size may be as high as 12%[[47](#_ENREF_47)]. There are multiple factors likely to contribute to missed polyps at colonoscopy including quality of bowel preparation, and the training and experience of the colonoscopist. The time taken by colonoscopists during withdrawal of the colonoscope from the caecum is a powerful predictor of adenoma detection rate (ADR)[[48](#_ENREF_48)]. Higher rates of interval cancers are seen in association with low ADR at screening colonoscopy[[49](#_ENREF_49),[50](#_ENREF_50)].

The protection afforded by colonoscopy is significantly greater in respect of distal CRC as compared to lesions of the proximal colon. There are a number of factors postulated to explain this differential: poorer right-sided bowel preparation, incomplete colonoscopy, anatomical factors impeding visibility, and potentially different biology of right-sided lesions, especially via the serrated pathway[[35](#_ENREF_35),[51](#_ENREF_51)].

Incomplete resection of adenomatous tissue is believed to be a substantial contributor to interval cancers. Rates of incomplete resection for diminutive polyps are 29% for conventional biopsy and 17% for hot biopsy[[52](#_ENREF_52),[53](#_ENREF_53)]. Residual polyp tissue is more likely to remain after resection of sessile polyps and risk increases with polyp size. Rates of 17% for polyps of 10-20 mm and 7% for lesions of 5-9 mm have been quoted. There also appears to be a higher rate of incomplete resection for serrated lesions in comparison to conventional adenomas (31% and 7% respectively)[[54](#_ENREF_54" \o "Pohl, 2013 #98)].

Missed lesions are likely to account for more than half of interval cancers diagnosed at 3 to 5 years after the index procedure[[55](#_ENREF_55" \o "Robertson, 2014 #99)]. Therefore, the quality of the index and subsequent colonoscopies is paramount in maximising the potential benefit of surveillance procedures. Quality of colonoscopy is directly associated with rates of interval CRC[[50](#_ENREF_50" \o "Corley, 2014 #94)].

**RATIONALE FOR SURVEILLANCE**

The major CRC mortality risk reduction is achieved at index colonoscopy, *i.e.,* diagnosis of cancers at an earlier stage and removal of adenomas with the aim of reducing CRC incidence.

Individuals found to have colonic polyps are at increased risk of advanced neoplasia in the future[[11](#_ENREF_11),[23](#_ENREF_23),[56](#_ENREF_56),[57](#_ENREF_57)]. This risk may be due to a number of mechanisms: (1) Missed lesions at the initial colonoscopy; (2) Incomplete removal of adenomatous tissue at initial colonoscopy; and (3) The individual’s propensity to colonic neoplasia (either lifestyle factors, an inherent imbalance of cell proliferation, or a combination of these)[[25](#_ENREF_25),[46](#_ENREF_46),[57-60](#_ENREF_57)].

In view of the increased risk of CRC, it seems logical that this group may benefit from closer monitoring than the general population. There are two reasons to consider surveillance colonoscopy in patients found to have adenomas at the index procedure. Firstly, as discussed above, there may be missed lesions, particularly small polyps, which may be identified at a subsequent procedure. Secondly, after a time interval, new lesions may have developed.

Although the risk of developing further adenomas is known, no randomised study has directly assessed the effect of post-polypectomy surveillance on CRC incidence or mortality. The efficacy of surveillance has been assessed by retrospective epidemiological series indicating that patients not entered into a surveillance programme have three- to fourfold greater risk of CRC. However, the increased risk pertains to those found to have advanced adenomas at the index procedure. Individuals with non-advanced adenomas did not have significantly higher risk than the general population[[23](#_ENREF_23),[60](#_ENREF_60)].

It is established that individuals with previously identified adenomas have an increased risk of further adenomas at a follow-up examination. At 4 year interval, 35.5% of patients will again be found to have at least one adenoma, but only 8.6%-12% will have advanced neoplasia (either an advanced adenoma or carcinoma) with 0.6% having carcinoma. Factors conferring higher risk of further adenomas at surveillance are age greater than 60 years, male sex, and the presence of more than one adenoma at the initial procedure. The finding of more than 2 adenomas at initial examination increases the risk of advanced neoplasia at follow-up examination[[32](#_ENREF_32),[61](#_ENREF_61)].

**Stratification**

Reported prevalence of adenomas ranges from 15%-40%, with advancing age and male sex associated with increasing prevalence. However, rates of adenoma detection may be as high as 50% in the general population when using modern “high definition” endoscopes[[62](#_ENREF_62),[63](#_ENREF_63)]. Therefore the number of patients who could potentially be offered surveillance colonoscopy is substantial.

To avoid unnecessary, or “low yield”, surveillance colonoscopies, it is necessary to identify those individuals with increased risk of CRC. This can be achieved through a risk stratification approach, as adopted by all the major current clinical guidelines (Tables 1-3).

Current guidelines vary in their definition of each risk group. However, there is consensus that individuals with one or two adenomas possessing no advanced features are classified as “low risk”. At the opposite end of the spectrum, it is agreed that finding high grade dysplasia or greater than 10 adenomas confers a “high risk”.

Current guidelines’ variability in recommendations is due to the lack of good quality evidence to support surveillance strategy.

United Kingdom guidelines do not take account of polyp architecture, while guidance in the United States and Europe classifies individuals with a villous adenoma as “high risk”.

In a comparison of current United Kingdom and United States guidelines, it was found that following United Kingdom guidelines would better identify a group of patients at high risk of advanced neoplasia: those with ≥ 5 small adenomas or ≥ 3 adenomas including at least one of ≥ 10 mm. These patients would be offered a surveillance interval of 3 years according to United States guidelines or 1 year according to United Kingdom guidance. At one year follow-up, this group had an 18.6% risk of advanced neoplasia[[64](#_ENREF_64" \o "Martinez, 2012 #129)].

Conversely, patients with 1 or 2 small adenomas would be classified as low risk by United Kingdom guidelines regardless of histology. This group could be at relatively high risk if histology revealed advanced adenomas (HGD or villous architecture) and as such would be advised 3 year surveillance under United States guidelines. The same group of patients could have been offered no surveillance by following United Kingdom guidelines, but have a 7.1% absolute risk of advanced neoplasia at 1 year[[64](#_ENREF_64)].

Current guidelines take account of findings at both the index and first surveillance colonoscopy in determining the second surveillance interval. This approach would be supported by a recent study showing that high risk features identified at either the index or first surveillance procedure increase the risk of advanced neoplasia at second surveillance[[65](#_ENREF_65)].

**SURVEILLANCE INTERVALS**

***High risk***

The evidence to support the use of surveillance applies predominantly to the “high risk” group. The incidence of advanced neoplasia and carcinoma in these individuals is significantly increased at follow-up, and CRC mortality is reduced by their surveillance[[33](#_ENREF_33),[59](#_ENREF_59),[60](#_ENREF_60)].

Data from the United Kingdom screening programme shows that in high risk individuals (by United Kingdom guidelines), the overall yield for advanced neoplasia at first surveillance (at 12 mo) was 6.6%, with a yield of 0.8% for CRC. These findings would support the current strategy of 12 mo surveillance in this group[[66](#_ENREF_66" \o "Lee, 2013 #111)]. The same study found that villous architecture and a right-sided adenoma at the index procedure were associated with an increased risk of finding advanced neoplasia at 1 year follow-up. Therefore within the high risk group, there are other factors which could be used to further inform the appropriate surveillance interval for an individual.

Current United States guidelines classify patients with > 10 adenomas as highest risk. However, as only 0.1% of screening patients fall into this category, its clinical utility is limited.

***Low risk***

Within the low risk group, it is known that the absolute risk of advanced neoplasia at follow-up is low. Current guidelines are based on evidence that this group carries no increased risk of CRC compared to the general population[[23](#_ENREF_23),[25](#_ENREF_25)]. A recent meta-analysis suggested individuals in the low risk group at the index procedure have a higher risk of advanced neoplasia at follow-up compared to those found to have no adenoma[[67](#_ENREF_67" \o "Hassan, 2014 #112)]. However, the absolute risk in both groups remains very low.

On the basis that the low risk group carry a risk of CRC equivalent to the general population, the guidelines advise surveillance at the interval prescribed by the relevant screening programme, *i.e.,* effectively advising no increased surveillance over that of the general population. The United Kingdom guidelines allow for deviation from this rule in that the low risk group may be offered no surveillance or a further procedure at 5 years. Of note, the United Kingdom NHS Bowel Cancer Screening Programme (BCSP), while following United Kingdom guidelines (BSG, 2010 and NICE, 2011), offers no surveillance in this group.

Recent data from Norway suggest a significant reduction in CRC mortality at 7.7 years in “low risk” patients after a single screening examination[[68](#_ENREF_68" \o "Loberg, 2014 #23)]. However, the definition of “low risk” used in this study differs from that used in current guidelines as the study authors used cancer registry data and so did not have access to details of polyp size or number. Therefore, all patients with “multiple” polyps or with histology showing either villous architecture or high-grade dysplasia were classified as “high-risk”. This definition makes comparison with other studies difficult.

***Intermediate risk***

Current guidelines differ most in recommendations for individuals with intermediate risk. It is in this group of patients that the benefit of surveillance is most uncertain.

Patients with 3 or 4 diminutive adenomas at index colonoscopy would be offered a surveillance procedure at 3 years according to United Kingdom, European, and United States guidelines. However, there is little evidence that this group of patients carries any significantly increased CRC risk compared to the general population.

There is evidence for the increased risk of identifying further adenomas at first surveillance in patients classified as intermediate risk at index procedure. However, the relative risk varies within this group of individuals dependent upon factors such as polyp size, patient age, and the presence of advanced adenoma at the index procedure, *i.e.,* with the varying definition of intermediate risk[[69](#_ENREF_69)]. Evidence for an effect of surveillance on CRC incidence and mortality is lacking.

***Serrated lesions***

American and European guidelines include serrated polyps in their recommendations, which are not specifically dealt with in United Kingdom guidelines.

Serrated polyps are known to be more challenging to identify at colonoscopy and their predilection for the proximal colon is thought in part to explain the relatively lower protective effect of colonoscopy on incidence of right-sided CRCs[[10](#_ENREF_10)].

Significant variability in detection of these lesions by endoscopists and their classification by pathologists has caused evidence on their natural history and risk profile to be lacking. However, further study and increased awareness of these lesions is likely to lead to further recommendations for surveillance in individuals found to have serrated polyps.

**DISADVANTANGES AND LIMITATIONS OF SURVEILLANCE**

At present, surveillance procedures account for 20%-30% of capacity in endoscopy departments: approximately the same proportion as primary screening procedures[[70-73](#_ENREF_70" \o "Radaelli, 2012 #10)]. It is likely that demand for surveillance procedures will increase in line with more widespread implementation of screening programmes, rising adenoma detection rates associated with modern endoscopes and rising quality standards, and the increased recognition and surveillance of serrated lesions.

While colonoscopy is a generally safe procedure, there is a risk of major complications[[74](#_ENREF_74" \o "Levin, 2006 #108)]. As such, the decision to proceed with surveillance colonoscopy must be informed by both the risk of CRC and the risk of a complication related to the procedure. Additionally, even an uncomplicated colonoscopy may represent considerable burden on the patient, who undergoes bowel preparation, time off work, and potential discomfort during the procedure. Fear of pain during the procedure is known to reduce the uptake of screening colonoscopy[[75](#_ENREF_75),[76](#_ENREF_76)]. For surveillance programmes to be effective, uptake must be maximised. By definition, individuals invited for surveillance already have personal experience of colonoscopy. This experience is likely to inform the individual’s decision on whether to undergo a surveillance procedure, highlighting the importance of patient experience during colonoscopy.

**WHEN TO STOP SURVEILLANCE**

The decision to discontinue surveillance is guided in current literature only on the criterion of the patient’s chronological age[[77](#_ENREF_77)]. It is known that rates of complications and post-procedure hospital admission are increased with advancing age and multi-morbidity. Advancing age also reduces the potential survival benefit in surveillance: as progression from adenoma to carcinoma is likely to take around 10 years, patients with a life expectancy of a similar or shorter time have little chance of benefit from a surveillance colonoscopy.

However, the use of chronological age alone is an over-simplification of the decision to discontinue surveillance: a decision which must balance the relative risks for the individual.

Patients found at their initial procedure to have an advanced adenoma, have a CRC risk similar to that of the general population after just one surveillance follow-up colonoscopy[[23](#_ENREF_23),[59](#_ENREF_59)]. Further study is needed to identify more detailed criteria to guide the decision on continued surveillance.

**ADHERENCE**

There is strong evidence that adherence to current guidelines by physicians is highly variable[[78](#_ENREF_78)]. Some surveillance procedures are performed earlier than advised, some late, and some not performed at all. Clinical guidelines are only a guide to clinicians and many will choose to advise a different approach for an individual patient.

Also, patients may choose not to be subjected to surveillance procedures for multiple reasons including their experience of colonoscopy and the perceived benefits of surveillance. The subject of patient choice in surveillance is an area requiring further study.

**FURTHER STUDY**

As discussed in the introduction to this paper, progression from adenoma to cancer usually occurs over many years. As such, the benefits of surveillance of colonic adenomas in reducing morbidity and mortality can only be realised over the long term. The introduction of surveillance programmes has become widespread only in recent years, so far limiting the available data on long-term follow-up. The known increased risk of CRC in patients found to have adenomas would make a randomised trial comparing surveillance to no surveillance unethical. Therefore, further study of the data from the era of widespread adenoma surveillance is needed to better inform future practice.

Current guidelines base recommendations on data collected prior to the widespread implementation of population screening programmes and prior to the use of robust quality metrics in colonoscopy. These factors may significantly alter the population classified within each risk group and so have a major impact on the outcomes of each group. More contemporary data from the era of high quality colonoscopy and population screening may allow more accurate risk stratification to better utilise limited colonoscopy resources in the future.

***future of adenoma surveillance***

The table 4 summarises suggested surveillance intervals based on current knowledge on risk stratification by polyp factors.

Polyp factors may be used, as in current guidelines, to determine surveillance interval. However, including other patient factors in this assessment may allow more accurate risk stratification. Possible factors include age, sex, family history of colorectal cancer, smoking status, or obesity.

Additionally, this combination of polyp and patient factors may further inform the decision on whether to continue with any further surveillance after the first surveillance procedure, as it is the first surveillance procedure that has greatest effect in reducing the future risk in the highest risk patients.

**CONCLUSION**

Internationally, increasing numbers of patients are embarking upon a course of surveillance colonoscopies due to the polyps discovered at the time of a previous examination. Each colonoscopy involves the burden of bowel preparation, potential anxiety and discomfort, and risk of complication for the patient. In many health settings, colonoscopy is a finite resource and so must be recommended only with a strong indication.

It is believed that individuals with non-advanced adenomas have no significantly increased risk of colorectal cancer compared to the general population. In addition, patients found at their initial procedure to have an advanced adenoma, have a CRC risk similar to that of the general population after just one surveillance follow-up colonoscopy[[23](#_ENREF_23),[59](#_ENREF_59)].

As shown in this review, there is some retrospective evidence to support surveillance procedures in patients at the highest risk of CRC. For those at lower risk, further evidence is needed to better stratify risk and so inform discussions between the individual and their clinician on whether surveillance colonoscopy is appropriate.

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**Table 1 British Society of Gastroenterology guidelines 2010[**[**79**](#_ENREF_79)**], supported by the 2011 guidelines of The National Institute for Health and Care Excellence**

Risk of colorectal cancer or advanced adenomas (≥ 1 cm as measured at endoscopy or high-grade dysplasia)

Patients with only one or two small (< 1 cm) adenomas are at low risk, and need no colonoscopic surveillance or 5-yearly until one negative examination then cease surveillance. Recommendation grade: B.

 Patients with three or four small adenomas or at least one adenoma ≥ 1 cm are at intermediate risk and should be screened 3-yearly until two consecutive examinations are negative. Recommendation grade: B.

If either of the following is detected at any single examination (at baseline or follow-up): ﬁve or more adenomas, or three or more adenomas at least one of which is ≥ 1 cm, the patient is at high risk and an extra examination should be undertaken at 12 mo before returning to 3-yearly surveillance. Recommendation grade: B.

Patients can be offered surveillance until age 75 yr and thereafter continue depending on relative cancer risk and comorbidity. Colonoscopy is likely to be less successful and more risky at older ages. Further, the average lead time for progression of an adenoma to cancer is 10 years which is of the same order as the average life expectancy of an individual aged 75 yr or older, suggesting that most will not beneﬁt from surveillance. Recommendation grade: B.

These guidelines are based on accurate detection of adenomas, otherwise risk status will be underestimated. Patients with a failed colonoscopy, for whatever reason, should undergo repeat colonoscopy or an alternative complete colonic examination. Recommendation grade: B.

The site of large sessile adenomas removed piecemeal should be re-examined at 2-3 mo. Small areas of residual polyp can then be treated endoscopically, with a further check for complete eradication in 2-3 mo. India ink tattooing aids recognition of the polypectomy site at follow-up. If extensive residual polyp is seen, surgical resection needs to be considered, or alternatively referral to a colonoscopist with special expertise in advanced polypectomy techniques. If there is complete healing of the polypectomy site, then there should be a colonoscopy at 1 yr, to check for missed synchronous polyps, before returning to 3 yearly surveillance. Recommendation grade: B.

**Table 2 American Gastroenterological Association 2012[**[**80**](#_ENREF_80)**]**

|  |  |  |
| --- | --- | --- |
| **Findings at index procedure** | **Suggested surveillance interval** | **Strength of evidence** |
| No polyps/small (< 10 mm) rectosigmoid hyperplastic | 10 yr | Moderate |
| 1-2 small (< 10 mm) tubular adenomas | 5–10 yr | Moderate |
| 3-10 tubular adenomas | 3 yr  | Moderate |
| > 10 adenomas | < 3 yr | Moderate |
| One tubular adenoma ≥ 10mm | 3 yr | High |
| One villous adenoma | 3 yr | Moderate |
| Adenoma with high grade dysplasia (HGD) | 3 yr | Moderate |
|  |  |  |
| **Serrated lesions** |  |  |
| Sessile serrated polyp (SSP) < 10 mm with no dysplasia | 5 yr | Low |
| SSP ≥ 10 mm OR with dysplasia OR serrated adenoma | 3 yr | Low |
| Serrated polyposis syndrome | 1 yr | Moderate |

**Table 3 European Society of Gastrointestinal Endoscopy 2013[**[**81**](#_ENREF_81)**]**

The following recommendations for post-polypectomy endoscopic surveillance should be applied only after a high quality baseline colonoscopy with complete removal of all detected neoplastic lesions.

In the low risk group (patients with 1–2 tubular adenomas < 10 mm with low grade dysplasia), the European Society of Gastrointestinal Endoscopy (ESGE) recommends participation in existing national screening programmes 10 years after the index colonoscopy. If no screening programme is available, repetition of colonoscopy 10 years after the index colonoscopy is recommended (strong recommendation, moderate quality evidence).

In the high risk group (patients with adenomas with villous architecture or high grade dysplasia or ≥ 10 mm in size, or ≥ 3 adenomas), the ESGE recommends surveillance colonoscopy 3 yr after the index colonoscopy (strong recommendation, moderate quality evidence). Patients with 10 or more adenomas should be referred for genetic counselling (strong recommendation, moderate quality evidence).

In the high risk group, if no high risk adenomas are detected at the first surveillance examination, the ESGE suggests a 5-yr interval before a second surveillance colonoscopy (weak recommendation, low quality evidence). If high risk adenomas are detected at first or subsequent surveillance examinations, a 3-yr repetition of surveillance colonoscopy is recommended (strong recommendation, low quality evidence).

The ESGE recommends that patients with serrated polyps < 10 mm in size with no dysplasia should be classified as low risk (weak recommendation, low quality evidence). The ESGE suggests that patients with large serrated polyps (≥ 10 mm) or those with dysplasia should be classified as high risk (weak recommendation, low quality evidence).

The ESGE recommends that the endoscopist is responsible for providing a written recommendation for the post-polypectomy surveillance schedule (strong recommendation, low quality evidence).

**table 4 adenoma surveillance**

|  |  |
| --- | --- |
| Findings at index procedure | Suggested initial surveillance interval |
| No adenomas | No surveillance |
| 1-2 adenomas with no advanced neoplasia | No surveillance |
| 3-4 adenomas with no advanced neoplasia | 3 yr |
| ≥ 3 adenomas and advanced neoplasia | 1 yr |
| ≥ 5 adenomas | 1 yr |