My approach to serrated polyps of the colorectum

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Hyperplastic polyps of the colorectum are heterogeneous lesions, a subset of which is now regarded as the precursor of colorectal cancer with DNA microsatellite instability. Some authors have distinguished this subset from classic hyperplastic polyps and have introduced the term “sessile serrated adenoma”. These lesions frequently show BRAF mutation and DNA methylation. This personal perspective reviews recent insights into serrated polyps and highlights the importance of inhibition of apoptosis as a unifying mechanism. It is estimated that around 25 hyperplastic polyps of the proximal colon exist for every colorectal cancer with DNA microsatellite instability. Further research is required to identify additional risk factors for hyperplastic polyps other than anatomical location. These may be demographic, clinical, morphological, or molecular. It is not recommended that the term sessile serrated adenoma be used in routine reporting, but it is desirable that potentially aggressive hyperplastic polyps should be identified for the purposes of both clinical practice and research.

During the past few years, it has become clear that hyperplastic polyps of the colorectum can no longer be dismissed as “non-neoplastic lesions with no malignant potential”. The basis for this premise has been published in pathological, clinical, and basic science literature, and has been incorporated into standard texts, including the most recent World Health Organisation (WHO) classification of tumours of the digestive system. This new position brings with it several problems that need to be resolved. First, the fact that a statement is true and has been widely published does not mean that it has been generally accepted and incorporated within routine clinical practice. Nevertheless, it is expected that scientific evidence will ultimately triumph over dogma with time. Second, as is the case for colorectal adenomas, it is clear that most hyperplastic polyps are clinically unimportant. That is, if left alone, most would not progress to cancer. Hyperplastic polyps in the distal colorectum apparently do not predict the presence of clinically important pathology in the proximal colon, and neither do they predict the development of significant lesions in the future. However, as is the case with colorectal adenomas, there is evidence that certain types of hyperplastic polyp are linked with colorectal neoplasia. On this basis, the third problem centres upon how we recognise these polyps and introduce the term that should be used for naming these high risk polyps in reports to clinicians. The issue of nomenclature is by no means trivial and settling on internationally approved terms and definitions for pathological lesions can take many years of rancorous debate. The current WHO classification includes reference to hyperplastic polyp, mixed hyperplastic polyp/adenoma, and serrated adenoma. There is no existing customised label for a particular type of hyperplastic polyp that may be of clinical concern.

THE CONCEPT OF “SERRATED POLYPS”

The term “serrated polyp” was introduced to conceptualise the relatedness of hyperplastic polyps and serrated adenomas. Before this point, serrated adenomas were conceived as variant adenomas and grouped with adenomas as bona fide neoplasms. The WHO classification continues to group serrated adenoma with adenomas and to retain hyperplastic polyps as a separate category. Nevertheless, mixed polyps frequently represent the combination of hyperplastic polyp and serrated adenoma. In addition, serrated adenomas and hyperplastic polyps have three key molecular features in common. First, they both show mutation of genes in the mitogen activated protein kinase signalling pathway: BRAF or K-ras. Second, they both show extensive DNA methylation. Third, they both show gastric metaplasia. The “serrated pathway” of colorectal neoplasia has been linked with a particular subtype of sporadic colorectal cancer that is also characterised by DNA methylation, mutation of either BRAF or K-ras, and gastric metaplasia. In addition, these cancers usually show DNA microsatellite instability to a high (MSI-H) or low degree. The morphological features of classic serrated adenomas have been reviewed in detail elsewhere. Briefly, serrated adenomas differ from classic hyperplastic polyps in showing unequivocal epithelial dysplasia, increased architectural complexity, pronounced cytoplasmic eosinophilia, absence of thickening of the basement membrane underlying the surface epithelium, and a relative lack of endocrine cells.

“The hyperplastic polyp can be defined as a lesion caused by the inhibition of programmed cell death or apoptosis”

Abbreviations: MSI, microsatellite instability; MSI-H, high degree of microsatellite instability; MUHC, McGill University Health Centre; WHO, World Health Organisation
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From mitochondria. BRAF mutation and DNA methylation example, oncogenic BRAF appears to inhibit caspases at a certain level from classic hyperplastic polyps. Both lesions will arise in serrated adenomas than in classic hyperplastic polyps.16 37 The same changes occur more frequently in sessile serrated adenomas in the articles mentioned above as large hyperplastic polyps. For this reason, the alternative term “sessile serrated polyp” was suggested. Although this adequately describes these lesions, it could be argued that the same term describes the entire spectrum of sessile serrated polyps from classic hyperplastic polyp through to serrated adenoma. It may be questioned whether the sessile serrated adenomas of Torlakovic and colleagues33 and Goldstein and colleagues34 are fundamentally different at the biological level from classic hyperplastic polyps. Both lesions will arise through inhibition of apoptosis. However, the specific mechanisms underlying apoptosis inhibition may differ and certain mechanisms may result in a more profound tissue disturbance among the sessile serrated adenomas. For example, oncogenic BRAF appears to inhibit caspases at a point downstream of BAD mediated release of cytochrome c from mitochondria. BRAF mutation and DNA methylation are closely correlated with sporadic MSI-H colorectal cancer. The same changes occur more frequently in sessile serrated adenomas than in classic hyperplastic polyps.16 37

If there are aggressive hyperplastic polyps then it is desirable that these are recognised and highlighted in reports to the clinician. There is the issue of increased malignant potential and lesions that are considered to be premalignant must be fully excised. There is also the issue of polyps serving as biomarkers for increased risk of metachronous lesions and therefore the introduction of colonoscopic surveillance. The hope of finding a single reliable marker for aggressive hyperplastic polyps may not be realised for some time. Despite decades of research into the behaviour of adenomas, we still do not know which adenomas are aggressive. Yet, there is a principle that should be followed. One first decides upon a clinically important endpoint such as malignant change or prediction of significant remote pathology in terms of type, time, and location. Then one identifies biomarkers that independently predict the endpoints of concern. These biomarkers could be demographic (for example, race, sex, or age), clinical (for example, family history, smoking, or anatomical site), pathological (for example, size, multiplicity, or dysplasia), or molecular (for example, mutation of BRAF or DNA methylation). Different sets of biomarkers may be required to predict different clinical endpoints.

“Despite decades of research into the behaviour of adenomas, we still do not know which adenomas are aggressive”

At this point in time we do not know which features would serve as reproducible and independent markers of high risk hyperplastic polyps, and neither is there an agreed nomenclature for high risk hyperplastic polyps. In the USA, only the diagnosis of adenoma triggers funded follow up surveillance procedures. Perhaps the need to communicate an appropriate level of clinical surveillance influenced the decision to use the term sessile serrated adenoma. Although expedient, this is not the most scientific rationale for ascribing terminology. To progress this issue, a clinical imperative is required. The first step will be the general acceptance that the status quo regarding hyperplastic polyps is wrong. This point of assent is yet to be realised.

**MAGNITUDE OF RISK OF MALIGNANT CHANGE WITHIN HYPERPLASTIC POLYPS**

Although it is likely that hyperplastic polyps from the proximal colon are linked histogenetically with the subset of colorectal cancers showing MSI-H and/or DNA hypermethylation, it is clear that most right sided hyperplastic polyps will not become malignant. In a postmortem study conducted in New Zealand there were 43 right sided hyperplastic polyps among 333 subjects, or one hyperplastic polyp in eight subjects. One would expect to see one MSI-H colorectal cancer in approximately 200 subjects on the basis that the lifetime risk of developing colorectal cancer is approximately 5% but only 10% of sporadic colorectal cancers are MSI-H. Therefore, very approximately, only about one in 25 right sided hyperplastic polyps (dividing 200 by eight) might be expected to convert into an MSI-H cancer. This estimate does not include the non-MSI-H colorectal cancers with extensive DNA methylation that may also arise in hyperplastic polyps. These calculations are crude, but indicate that the removal of a relatively large flat lesion from the thin walled right colon in an elderly subject carries risks that may not necessarily be balanced by clinical benefit. Nevertheless, the malignant conversion rate for a right sided hyperplastic polyp is approximately the same as that for a colorectal adenoma.

In an unpublished series of 1436 colonoscopically derived polyps collected at the McGill University Health Centre (MUHC), Montreal, Canada, there were 51 right sided hyperplastic polyps and 251 left sided hyperplastic polyps, including the variant hyperplastic polyp described as sessile serrated adenoma. Twelve of the 51 right sided hyperplastic polyps and 18 of the 251 (7%) left sided hyperplastic polyps showed the features of sessile serrated adenoma (table 1). Therefore, sessile serrated adenomas appear to show a predilection for the proximal colon when compared with classic hyperplastic polyps. Others report a somewhat higher frequency of sessile serrated adenomas in both the right and left colorectum, no doubt because of differing diagnostic thresholds. Although there is no direct evidence that left sided hyperplastic polyps confer an increased risk of malignancy, even when they show the features of sessile serrated adenoma, it cannot be assumed that hyperplastic polyps with malignant potential are restricted to the proximal colon. The polyps from the same MUHC series included 16 mixed polyps of various types (table 1). Among these were six left

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**Figure 2** High power view of extremely dilated crypts and relative absence of lamina propria in a sessile serrated adenoma (haematoxylin and eosin stain).
A subset of hyperplastic polyps has been linked with colorectal cancer showing DNA methylation and microsatellite instability.

Features of hyperplastic polyps with increased malignant potential include large size, multiplicity, location in the proximal colon, and a sessile growth pattern.

Hyperplastic polyps with malignant potential have been distinguished from classic hyperplastic polyps on the basis of subtle microscopic features that include increased s serration, crypt dilatation, horizontal crypts, and hypermucinous epithelium.

Several diagnostic terms have been introduced for variant hyperplastic polyps, including “sessile serrated adenoma.”

A histological distinction between classic hyperplastic polyp and sessile serrated adenoma cannot be achieved in all cases.

Sessile serrated adenomas are characterised by frequent mutation of BRAF and DNA methylation, whereas traditional hyperplastic polyps are more likely to have K-ras mutation and less extensive DNA methylation.

Although most right sided hyperplastic polyps or sessile serrated adenomas will not progress to cancer, the magnitude of risk is probably comparable to that of traditional colorectal adenoma.

Clinicians should be made aware of the increased malignant potential of right sided hyperplastic polyps or sessile serrated adenomas.

A PERSONAL DIAGNOSTIC APPROACH

The presence of a right sided hyperplastic polyp is recorded and attention is drawn to the increased potential of these lesions for future malignancy. The risk of future malignancy is likely to be higher in the case of right sided hyperplastic polyps that are unusually large, multiple, include dysplastic subclones (mixed polyp), have the features that have been associated with the variant hyperplastic polyp described as sessile serrated adenoma, or are associated with coexisting adenomas. Terms such as sessile serrated adenoma or sessile serrated polyp are not used in reports to the clinician. However, it is appropriate to highlight variant hyperplastic polyps with increased malignant potential in publications of basic and clinical research. Routine testing for MSI or for loss of DNA mismatch repair genes by immunohistochemistry is not undertaken because these alterations generally occur only with the advent of unequivocal dysplasia (intraepithelial neoplasia). It is possible that the establishment of deficient DNA mismatch repair results in rapid malignant evolution that would be analogous to the “aggressive adenomas” associated with hereditary non-polyposis colorectal cancer. Therefore, multiple slices through large hyperplastic polyps should be taken to exclude the presence of dysplasia. The new insights outlined above signal an important change in the management of serrated polyps of the colorectum.

**Take home messages**

- A subset of hyperplastic polyps has been linked with colorectal cancer showing DNA methylation and microsatellite instability.
- Features of hyperplastic polyps with increased malignant potential include large size, multiplicity, location in the proximal colon, and a sessile growth pattern.
- Hyperplastic polyps with malignant potential have been distinguished from classic hyperplastic polyps on the basis of subtle microscopic features that include increased serration, crypt dilatation, horizontal crypts, and hypermucinous epithelium.
- Several diagnostic terms have been introduced for variant hyperplastic polyps, including “sessile serrated adenoma.”
- A histological distinction between classic hyperplastic polyp and sessile serrated adenoma cannot be achieved in all cases.
- Sessile serrated adenomas are characterised by frequent mutation of BRAF and DNA methylation, whereas traditional hyperplastic polyps are more likely to have K-ras mutation and less extensive DNA methylation.
- Although most right sided hyperplastic polyps or sessile serrated adenomas will not progress to cancer, the magnitude of risk is probably comparable to that of traditional colorectal adenoma.
- Clinicians should be made aware of the increased malignant potential of right sided hyperplastic polyps or sessile serrated adenomas.

**REFERENCES**


COX-2 is strongest predictor of early death in malignant mesothelioma

New findings may help to confirm how malignant mesothelioma develops, as cyclooxygenase-2 (COX-2) expression has been shown as a strong indicator of poor survival independently of other molecular markers previously thought to be involved. Only expression of COX-2 (hazard ratio 1.143), not of cell cycle inhibitors p21 and p27, was significantly associated with survival of patients with mesothelioma in multivariate analysis. Univariate analysis showed that high expression of COX-2 and low expression of p21 and p27 significantly reduced survival (from median 12–14 weeks to 5 weeks). Expression of p53 tumour suppressor protein was not significant in survival, possibly because the tumours were positive for SV40 sequences. COX-2 expression was not apparently related to tumour type—whether epithelioid, sarcomoid, or of mixed histological type—all of which were represented.

The study cohort comprised 29 selected patients from 35 original patients available for follow up, all of whom were from one region in Italy and had mesotheliomas positive for SV40 virus sequences and p53 and p21 as determined previously. All patients had had surgery and 13 later had radiotherapy or chemotherapy. Expression of COX-2 and p27 was determined by histochemical staining of thin sections of biopsy specimens of the tumour with specific antibody. Patient survival was calculated from operation date.

The study confirms the role of COX-2 expression in determining survival in mesothelioma but is the first to investigate in vivo a potential relation with p53 and p21 and p27, which an earlier in vitro study had suggested might have an influence.