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The Serrated Polyp Pathway: Is it Time to Alter Surveillance Guidelines?

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Abstract

Purpose of the review—In this manuscript, we review current surveillance guidelines for serrated polyps (SPs) and discuss how recent studies inform the selection of appropriate surveillance intervals for patients with SPs.

Recent Findings—Large and/or proximal SPs, particularly sessile serrated polyps (SSPs), are associated with increased risk of both synchronous and metachronous neoplasia, including advanced adenomas and colorectal cancer (CRC). Persons harboring multiple SSPs or dysplastic SSPs are at the highest risk. Moreover, a high percentage of large and/or proximal SPs are reclassified as SSPs when read by trained gastrointestinal pathologists, even if they were originally reported as hyperplastic polyps. These findings support the adoption of surveillance guidelines that prescribe closer surveillance of large and/or proximal SPs, regardless of subtype.

Summary—SSPs remain a challenge to reliably identify, resect, and diagnose via histology. The increased risk of future neoplasia in patients with SSPs is likely driven by a combination of underdetection, inadequate removal, misclassification, and biology. Until further evidence emerges, we support guidelines that recommend close surveillance of patients with a history of large and/or proximal SPs and SSPs specifically in order to mitigate the threat of interval CRC.

Keywords

serrated polyp; sessile serrated polyp; sessile serrated adenoma; sessile serrated adenoma/polyp; surveillance; colorectal cancer

INTRODUCTION

Despite advances in screening, colorectal cancer (CRC) kills an estimated 50,000 people annually and remains the second-leading cause of cancer-related mortality in the United States [1]. Of concern, clinicopathological studies suggest that serrated polyps (SPs) are responsible for up to a third of sporadically-occurring CRCs [2]. Sessile serrated polyps (SSPs) are the most common premalignant SP subtype. Unlike more common conventional

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adenomas, SSPs are typically flat and elusive lesions that reside deep in the proximal colon, creating a unique challenge for those performing screening colonoscopy. Moreover, there is considerable variance in SSP detection rates and inconsistent pathological interpretation of these lesions [3]. As such, current surveillance guidelines for SPs vary substantially and are based on low quality evidence [4]. The purpose of this review is to provide a brief overview of SPs, particularly premalignant SPs such as SSPs and traditional serrated adenomas (TSAs), and discuss how recent epidemiological studies help inform current surveillance recommendations.

WHAT DO WE KNOW ABOUT SERRATED POLYPS?

Current taxonomy of serrated polyps

The World Health Organization (WHO) divides SPs into three distinct subtypes: hyperplastic polyps (HPs), SSPs, and TSAs [5]. Of these, true HPs are the most common, the most indolent, and are subclassified by the quantity of mucin they contain into microvesicular hyperplastic polyps (MVHPs), goblet cell hyperplastic polyps (GCHPs), and mucin-poor hyperplastic polyps (MPHPs) [6]. The prognostic significance of individual HP subtypes is uncertain, and thus pathologists do not typically use this nomenclature in clinical pathology reports.

SSPs are premalignant SPs identified by their classic “anchor” or “boot-shaped” crypt bases [2,7]. In contrast to HPs, SSPs tend to be larger than 5mm, proximally located, and have irregular borders (Figure 1) [8]. While other manuscripts use sessile serrated lesion (SSL), sessile serrated adenoma (SSA), or sessile serrated adenoma/polyp (SSA/P), we prefer the term SSP to prevent confusion with conventional adenomas, though this term also has its drawbacks [9].

TSAs are relatively rare premalignant SPs. In contrast to the majority of SPs, which are sessile in morphology, TSAs are more polypoid in form [10]. Histologically, they are characterized by perpendicular or “ectopic” crypt foci that branch out at obtuse angles, cells with eosinophilic cytoplasm, and pencillate nuclei.

Lesions with features of both SPs and conventional adenomas can be challenging to diagnose. It is worth noting that some adenomatous polyps can exhibit very mild crypt serration, yet still are best characterized as tubular adenomas [34]. There also may be a hybrid form of tubulovillous adenoma with serrated features [11]. The term “mixed polyp” is an anachronistic moniker that was usually applied to a lesion with features of both a SSP or HP and a conventional adenoma. It is now recognized that many lesions previously labeled mixed polyps were likely SSPs with cytological dysplasia (SSPDs) [2].

The pathways of serrated carcinogenesis

While conventional adenomas progress to CRC via a well-defined sequence of mutations, the mechanisms of serrated carcinogenesis are less well understood. However, early investigations suggest that multiple pathways exist.

The SSP pathway—The *BRAF* oncogene is the key instigator of the SSP pathway [12]. Mutations in *BRAF* cause uncontrolled cellular proliferation through the inhibition of apoptosis [13]. As the majority of MVHPs exhibit *BRAF* mutation, they are thought to be the precursors to SSPs [14]. Next, global hypermethylation leads to epigenetic silencing of key regulatory genes such as *MLH1*, a critical DNA mismatch repair gene [15]. Accumulation of deleterious mutations and epigenetic silencing facilitate progression from MVHP to SSP to SSPD and, ultimately, a form of CRC characterized as CpG island methylation phenotype-high (CIMP-H) with microsatellite instability (MSI) [12,16]. However, SSPs likely give rise to CIMP-H, microsatellite stable (MSS) cancers as well via different terminal mutations [2].

The TSA pathway—The molecular mechanisms of the TSA pathway are less well understood. Of note, TSAs are genetically and phenotypically more heterogeneous than SSPs. TSAs can be *BRAF* positive or negative and have high or low levels of epigenetic silencing [17]. Many TSAs also have a mutation in *KRAS*, an oncogene analogous to *BRAF* in the SSP pathway [18]. Some have speculated that there are two separate TSA pathways: one driven by mutations in *KRAS* with subsequent conventional dysplasia and a second characterized by *BRAF* mutations and subsequent serrated dysplasia [19]. In contrast to the SSP pathway, which typically results in MSI cancers, TSAs are thought to primarily give rise to MSS CRC [20].

Epidemiology of serrated polyps

At least a third of adults harbor SPs, and 70–90% of all SPs are HPs. [3,21,22]. In contrast to conventional adenomas, which are encountered in 30–40% of screened patients, the prevalence of SSPs is estimated to be between 2–20% [3,7,23–28]. The variation in reported data is likely related to substantial differences in polyp detection rates amongst practicing endoscopists as well as inconsistent pathological interpretation of these lesions. Fortunately, there is evidence that the detection of SPs is increasing significantly over time [3,29].

The bulk of epidemiological data on SPs was gathered well before the widespread adoption of the WHO taxonomy. As such, early investigations did not differentiate between subtypes of SPs. Moreover, even contemporary studies are burdened by frequent histopathological misclassification, notably the challenge in differentiating large and/or proximal HPs and SSPs.

Nonetheless, specific risk factors have emerged for SPs in general. A recent meta-analysis by Bailie et al identified smoking (relative risk [RR], 2.47; 95% confidence interval [CI], 2.12–2.87), alcohol (RR, 1.33; 95% CI, 1.17–1.52), and obesity (RR, 1.40; 95% CI, 1.22–1.61) as significant modifiable-risk factors for SPs [30]. With regards to non-modifiable risk factors, SPs appear to be more common in Whites than African-Americans or Hispanics [31,32].

For SSPs specifically, risk factor data are sparser. In contrast to conventional adenomas, SSPs are at least as common in females as in males [7,21,22]. Tobacco (RR, 3.40; 95% CI, 1.90–6.07) and alcohol use (RR, 1.85; 95% CI, 1.03–3.32), once again, appear to be

important risk factors [30]. Diets high in red meat and fat intake have also been linked to SSPs, while folate, fiber, and NSAID use appear to have a protective effect [30,33].

Natural history of serrated polyps and those who harbor them

Malignant potential—In general, HPs that are small and located in the distal colon are thought to have little or no malignant potential [34]. However, there is compelling evidence that large and/or proximal HPs increase the risk for advanced neoplasia [35–37]. While studies define large and proximal polyps differently, the conventions most frequently used in the literature are 10 mm for large polyps and proximal to the splenic flexure for proximal or right-sided polyps. Furthermore, data linking large and/or proximal HPs to CRC is confounded by the fact that many large and/or proximal HPs are reclassified as SSPs upon examination by trained gastrointestinal pathologists [38]. As such, these lesions require careful attention during endoscopy, in the pathology laboratory, and when selecting appropriate surveillance intervals. One caveat is that diminutive (< 5mm) true HPs located in the proximal colon are likely associated with low risk, especially when only 1 or 2 are present [34] (Table 1, Figure 1c).

In contrast, there is more straightforward evidence that SSPs and TSAs are capable of malignant transformation. Observational data suggest that the rate of low-grade dysplasia and high-grade dysplasia in SSPs is 12% and 2% respectively, and it is estimated that up to 6% of SSPs will develop into CRC [7,39]. TSAs are also capable of malignant transformation, but given their relative scarcity, less is known about their behavior compared to other serrated polyps [40].

Dwell time—The rate at which SPs progress to CRC or “dwell time” is of great debate and the target of active research. Interestingly, there are higher rates of serrated CRCs than SSPs, suggesting a truncated dwell time [16,41,42]. Also, a few case studies of SSPs left in-situ report progression to invasive CRC over a matter of months [43,44]. Conversely, Lash et al found that the median ages of SSPs, SSPDs, and SSPs with foci of adenocarcinoma suggests progression to CRC over a period of 15 years or more, and a recent population-based study out of Norway reported that of 23 large SPs left in situ for a median of 11 years, none developed into CRC [7,45]. Bettington et al. offers a solution to these conflicting observations [46]. Similarly to Lash et al, they noted that SSPDs are rare and occur in patients who are on average 17 years older than those harboring SSPs without dysplasia. Thus, they propose that SSPs remain quiescent for a number of years before accumulated mutations allow for the rapid transition to malignancy in the latter stages of serrated carcinogenesis.

Unfortunately, these studies are hindered by underdetection, inadequate resection, and misclassification of SPs. While understanding the natural history of SPs is essential to establishing appropriate surveillance intervals, studying the behavior of these premalignant lesions in vivo has important ethical and logistical limitations (Figure 2).

The risk of synchronous advanced colorectal neoplasia—Numerous studies have noted an increased risk of synchronous advanced colorectal neoplasia (SACN) in patients harboring SPs, particularly large and/or proximal SPs [37,47–49]. One large population-

based study from Spain reported an association between large SPs and SACN (odds ratio [OR], 2.49; 95% CI, 1.47–4.20) regardless of proximal (OR, 4.15; 95% CI, 1.69–10.15) or distal (OR, 2.61; 95% CI, 1.48–4.58) location [48]. These observations are further supported by aggregate data from Gao et al, which once again suggest an independent association between SACN and both large (OR, 4.10; 95% CI, 2.69–6.26) and proximal (OR, 2.77; 95% CI, 1.71–4.46) SPs [49]. Moreover, two recent investigations applying current WHO nomenclature found an increased risk for SACN in large and/or proximal HPs specifically [35,36]. Of importance, this association is likely influenced by the frequent pathologic misclassification of large and/or proximal HPs, which will be discussed in detail below. Fewer studies have measured the risk of synchronous lesions associated with SSPs specifically, but SSPs appear to be associated with a higher risk of SACN compared to proximal SPs in general and possibly a higher risk of SACN compared to conventional adenomas as well [23,35,36].

The risk of metachronous advanced neoplasia—SPs are also associated with an increased risk for future or metachronous advanced colorectal neoplasia (MACN). Unsurprisingly, large and/or proximal SPs appear to be of particular significance. Schreiner et al reported an elevated risk of MACN in patients with proximal SPs on baseline colonoscopy (OR, 3.14; 95% CI, 1.59–6.20), and a recent article by Melson et al suggests that the risk of MACN in low-risk SPs is comparable to that of high-risk conventional adenomas [37,50]. Moreover, a recent population-based study from Denmark reported an increased risk of metachronous CRC in patients harboring SSPs, especially those in the right colon (OR, 12.42; 95% CI, 4.88–31.58) [51]. The same study reported that the 10-year risk of CRC was 4.4%, 4.5%, and 2.3% in patients with SSPDs, TSAs, and conventional adenomas respectively, once again suggesting that the risk of MACN and CRC in patients harboring premalignant SPs is similar to or higher than that of conventional adenomas. Interestingly, in this study the presence of synchronous conventional adenomas on baseline examination did not affect the risk of CRC in patients with SSPs. However, there is some observational evidence to support a synergistic effect when both high risk conventional adenomas and SPs are present at index colonoscopy [52]. With respect to TSAs, the data are sparse with regards to the risk of associated MACN. One Korean study reported that compared to patients with conventional adenomas, patients with TSAs had higher risks of metachronous polyps, including advanced neoplasia [53].

Taken together, these studies suggest that the risk of SACN and MACN increases as one moves from distal to proximal colon, from small to large polyp size, and from HP to more advanced serrated lesions such as SSPs and TSAs. However, many formal post-polypectomy surveillance guidelines do not take into account these variables. Nor do they provide guidance in patients with concomitant SPs and conventional adenomas.

Pathologic interpretation of serrated polyps

While there is evidence that the detection of SPs is increasing over time, pathologic classification of HPs, SSPs, and TSAs remains inconsistent [3,29]. Multiple studies have shown that a significant number of large and/or proximal HPs are reclassified as SSPs when reviewed by a trained gastrointestinal pathologist [29,38,54,55]. In a single-center study out

of the UK, Gill et al reported that between 30–60% of proximal HPs were reclassified as SSPs over a 4-year period [29]. In a large, prospective, multi-center study out of Canada with 2,527 colonoscopies, 18% of HPs > 5mm and 41% of HPs ≥ 10 mm were reclassified as SSPs upon secondary review [55]. Of importance, only 26% of those with high-risk SSPs received appropriate follow-up, which was substantially lower than for patients with conventional adenomas (48.3%). These results were replicated in a recent study in Germany, which showed that reclassification lead to more frequent surveillance intervals in a third of patients with reclassified SPs [38].

As the magnitude of pathologic misclassification comes into focus, a few investigators have searched for tools to help pathologists identify patients at risk. Tinmouth et al. found no significant differences in patient characteristics between those with reclassified SSPs and those with true HPs > 5mm [55]. However, Schramm et al identified age > 65 (OR, 4.13; 95 % CI 1.22–14.2), snare polypectomy (OR, 23.6; 95 % CI 4.86–115), and concomitant conventional adenomas (OR, 7.56; 95 % CI 1.31–43.5) as predictors of reclassification [56]. Differences in gene expression may also aid pathologists in differentiating between HPs and SSPs [57,58]. However, even low cost interventions such as changes in post-resection handling and simplifying diagnostic criteria have been shown to significantly improve interobserver variation [59]. Additionally, a recent study showed that an online e-learning module significantly reduced interlaboratory variability in the diagnosis of SSP across the Netherlands [60].

WHAT ARE THE CURRENT SURVEILLANCE GUIDELINES FOR SERRATED POLYPS?

In light of the risk of SACN and MACN in patient's harboring SPs, Terdiman and McQuaid put forward the first formal recommendations for the surveillance of SPs [61]. They recommended 3 year intervals for proximal SPs, SPs ≥ 10mm, or SPs with cytological dysplasia. Since that time, multiple expert panels and professional societies have published detailed guidelines with regards to the management of HPs, SSPs, and TSAs (Table 1) [34,62–64]. Of these, the recommendations of the US Multisociety Task Force and the International Consensus Panel are the two most frequently encountered in practice in North America. Both of these guidelines use a conceptual framework that assumes the risk of CRC in patients with SPs is directly related to the size (large vs. small), location (proximal vs. distal), and histology (SSP vs. HP) of SPs. The main difference between these two is the treatment of large and/or proximal HPs, for which the International Consensus Panel recommends more frequent follow-up. Of note, many professional societies do not have detailed recommendations for SPs at this time, including the European Union (EU) and the Japanese Society of Gastroenterology (JSGE), amongst others [65–69, 76].

In appreciation of these challenges, we favor the International Consensus Panel's recommendations for the surveillance of SPs, which prescribe closer follow up of large and/or proximal HPs and reflect the aforementioned concerns with regards to the frequent pathological misclassification of these lesions. As multiple studies have shown that patients harboring large and/or proximal SPs have elevated risk of SACN and MACN, it is

reasonable to treat all large and/or nondiminutive proximal SPs (including HPs), as higher risk and worthy of closer surveillance until further evidence is available to guide practice.

Importantly, the appropriate surveillance of any colorectal lesion is dependent on the quality of the initial colonoscopy (i.e. adequate bowel preparation, cecal intubation, etc.) as well as the complete resection and appropriate histopathological classification of any observed premalignant lesions. In comparison to conventional adenomas, SPs pose a unique challenge on many of these fronts. In particular, there is evidence that rates of incomplete resection are significantly greater for SSPs than conventional adenomas [71]. Therefore, for larger SPs (> 2 cm), particularly those removed piecemeal, earlier surveillance (i.e. < 1 year) is indicated to ensure complete eradication [62].

This review focuses primarily on sporadically-occurring SPs, but it should be noted that some patients with SPs meet one of 3 WHO-defined criteria for serrated polyposis syndrome (SPS): 1) 5 or more SPs proximal to the sigmoid colon, at least 2 of which are ≥ 10mm, 2) any SP proximal to sigmoid with a family history of SPS; or 3) >20 SPs of any size distributed throughout the colon. SPS has been associated with an increased risk of CRC, and annual surveillance is generally recommended for SPS patients with intact colons [62].

WHAT ARE THE AREAS OF UNCERTAINTY RELATED TO SURVEILLANCE OF SERRATED POLYPS?

Current surveillance guidelines vary significantly and are not based on robust data. Despite active research, there remains much uncertainty and inconsistency with regards to the appropriate surveillance of SPs (Tables 1 and 2). Future guidelines must take into account the unique challenges posed by SPs, such as underdetection, technically difficult resection, and pathologic misclassification, amongst others.

As alluded to above, there is no guidance in cases where both SPs and conventional adenomas are present on index colonoscopy. Approximately a third of patients harboring SSPs have synchronous conventional adenomas, and there is concern that these patients may have “two hits” and be at increased risk for progression to CRC [45,52,74]. We typically manage these cases by adding together the number of SPs and conventional adenomas, and 3 or more combined serrated and adenomatous polyps triggers a 3 year surveillance examination.

While there is good evidence that small and distal HPs are benign, there is considerable uncertainty regarding guidance for managing patients with small HPs located in the proximal colon. The USMSTF recommends a 10-year follow-up for these lesions despite evidence that they may be associated with increased risk of SACN and MACN. As mentioned above, 1–2 diminutive true HPs in the proximal colon likely convey minimal risk, but larger (e.g. 6–9mm), multiple (> 3) polyps in the right colon that are read as hyperplastic should prompt consideration for closer surveillance.

Additionally, current recommendations are based solely on endoscopic and histopathologic polyp characteristics, and do not take into account known risk factors for serrated neoplasms

such as tobacco or alcohol use. Whether inclusion of these variables in screening or surveillance would be of benefit remains unknown. While molecular markers that predict MACN in patients with SPs have been identified, these are preliminary investigations, and more research is needed before they can be widely adopted [75].

Well-designed epidemiological and clinicopathological studies can help address current gaps in knowledge. Of note, the ongoing European Polyp Surveillance (EPoS) trials have an observational arm in which patients with high risk SPs (≥ 10 mm at any location or ≥ 5 mm and proximal to the splenic flexure) are offered 5 and 10 year follow-up intervals and should help better characterize the risk of SACN, MACN, and CRC in patients with these lesions [72]. Prospective trials utilizing formal training programs are needed to help set standard SP detection rates and decrease the variation that currently exists between practicing endoscopists. Histopathological investigations of microsatellite instable, proximal, and interval CRCs may help identify the features of high-risk premalignant lesions and have important implications for screening, surveillance, and treatment. Also, the development of technologies that improve detection and/or resection of SPs would be welcome tools to prevent CRC arising from serrated precursors, and there are some compelling recent reports along these lines [73].

Finally, it should be noted that adherence to standardized guidelines is historically inconsistent [70]. Therefore, even if perfectly evidence-based guidelines existed and were consistent across expert groups and specialty societies, there would still be challenges with respect to disseminating these recommendations and achieving consistent and optimal practices. This is a particular challenge in a rapidly evolving field such as serrated neoplasia research.

CONCLUSIONS

While the malignant potential of SPs has gained significant recognition over the last decade, little is known about the natural history of these lesions, and current surveillance recommendations are based on sparse evidence, though the evidence basis is growing. As multiple studies have documented the risk of SACN and MACN in patients with large and/or proximal SPs as well as frequent misclassification of these lesions, we favor more conservative surveillance intervals such as those put forward by the International Consensus Panel at this time. More research is needed to optimize the management of SPs; current surveillance guidelines are likely to change as additional data becomes available.

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Figure 1.

Endoscopic images of serrated polyps, representing typical and atypical examples. A) Large (12mm) proximally-located SSP at the hepatic flexure; B) Small (5mm) distally located SSP in the sigmoid colon; C) Small (2mm) proximally-located HP in the ascending colon; and D) Small (6mm) proximally-located SSP in the ascending colon.

SSP: sessile serrated polyps, HP: hyperplastic polyp

Figure 2.

Important issues to consider when studying the natural history of patients with sessile serrated polyps

SSP: sessile serrated polyp

Table 1

Published guidelines for the post-polypectomy surveillance of serrated and adenomatous polyps

		Guideline recommended surveillance intervals							
Polyp findings	Definition	International Serrated Consensus Panel [34]	United States Multi-Society Task Force [62]	British Society of Gastroenterology [65][76]	European Union Guidelines [66]	European Society of Gastrointestinal Endoscopy [69]	Japanese Society of Gastroenterology ^f [67]	Korean Multi-society Task Force [64]	Cancer Council of Australia ^h [68]
Low Risk Adenoma	1–2 conventional adenomas, <10mm in size	NR	5–10 years	5–10 years	Routine screening	Routine screening	3–10 years	5 years	5 years
High Risk Adenoma	3 conventional adenomas, ≥10mm in size or villous or HGD	NR	3 years	1–3 years ^a	1–3 years ^a	3 years	3 years	3 years	3 years
Low risk HP	Small (<10mm) rectosigmoid HPs	10 years	10 years	No surveillance	Routine screening	Routine screening	NR	NR	10 years
Intermediate risk serrated polyp	1–3 small (<6mm) proximal HPs	10 years	NR	No surveillance	NR	Routine screening	NR	NR	NR
	Large (≥10mm) HP	5 years	NR	No surveillance	NR	3 years	NR	3 years ^g	NR
	>3 proximal HP	5 years	NR	No surveillance	NR	Routine screening	NR	NR	NR
High risk serrated polyp	1–2 SSP, <10mm in size	5 years	5 years	No surveillance	NR	Routine screening	NR	NR	5 years
	Large (≥10mm) SSP	3 years	3 years	3 years	NR	3 years	NR	3 years	3 years
	3 SSP	3 years	3–5 years	No surveillance	NR	Routine screening	NR	NR	3 years
	SSP with cytological dysplasia	1–3 years	3 years	3 years	NR	3 years	NR	NR	5 years ^b
	TSA	3–5 years ^b	3 years	3 years	1–10 years ^c	3 years ^d	NR	3–5 years ^g	3–5 years
Serrated polyposis syndrome	WHO criteria (see text)	1 year	1 year	1–2 years	NR	NR ^e	NR	NR	NR

^aBritish and EU guidelines stratify higher risk adenomas into intermediate (3–4 small adenomas, <20mm: 3 year surveillance) and high risk categories (≥5 conventional adenomas or any ≥20mm: 1 year surveillance).

^bConsensus panel recommends 3 year interval for large or multiple (≥3) TSAs

^cEU guidelines recommend managing TSAs identical to conventional adenomas, which could result in interval from 1–10 years based on size and multiplicity

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^dESGE guidelines recommend 3 year surveillance for any serrated polyp 10mm (HP, SSP, or TSA). Guideline is ambiguous as to management of small or nondysplastic TSAs.

^eESGE guidelines do recognize SPS and recommend referral to genetic counselling for SPS but do not recommend a specific surveillance interval for these patients.

^fJapanese guidelines do not recommend resection of diminutive polyps 5mm in diameter, regardless of suspected histology. When removed, 3 year surveillance recommended for any adenoma.

^gKorean guidelines recommend 3 year surveillance for any serrated polyp 10mm (HP, SSP, or TSA). Small (<10mm) TSA would fall into low risk category (5 year surveillance).

^hAustralian guidelines recommend managing SSPs and TSAs identical to conventional adenomas, with 3–5 year surveillance based on number and size. Only high grade dysplasia (rare in SSPs) considered high risk.

HGD: high grade dysplasia; HP: hyperplastic polyp; NR: no recommendation or not specified; SSP: sessile serrated polyp; TSA: traditional serrated adenoma; WHO: World Health Organization

Table 2

Uncertainties in management of serrated polyps

Scenarios	Examples of polyp findings	MSTF guideline recommended surveillance	Our approach	Rationale
Single large right sided HP	12 mm flat polyp in ascending colon, read as hyperplastic by pathologist	10 years	5 year follow up	Right sided serrated polyps (even those read as HPs) have been associated with increased risk of SACN and MACN. SSPs may be misinterpreted as HPs.
3 combined small SSPs + conventional adenomas	8mm SSP in transverse colon + two 3 and 5mm tubular adenomas in the sigmoid colon	5 years	3 years [for 3 total number of conventional adenomas + SSPs]	SSPs and conventional adenomas are both premalignant lesions. Some studies suggest that patients with both polyp types are at increased risk of MACN.
Proximal HP that was biopsied only or may have been incompletely resected	“Strange looking fold” in ascending colon that is biopsied, read as hyperplastic tissue by pathologist	No specific recommendation, 10 year interval could be extrapolated given hyperplastic histology.	Repeat within 1 year for complete resection	Biopsy sampling of larger serrated lesions makes pathologic determination challenging and biopsies of SSPs are more likely to be read as hyperplastic due to insufficient material for pathologic diagnosis.
“Mixed polyps”	9mm multilobulated polyp in transverse colon, read as “mixed polyp” by pathologist	No specific recommendation. 5 year interval could be extrapolated if treating as a small conventional adenoma.	3 years. Consider earlier follow up if complete resection in doubt.	Polyps with features of both serrated polyps and conventional adenomas or adenomatous dysplasia were previously labeled “mixed polyps” by some pathologists. In most cases these lesions represent SSPs that have developed a focus of dysplasia and are thus higher risk. SSPs with dysplasia have a morphology and size that increases the risk of incomplete resection.

HP: hyperplastic polyp; MACN: metachronous advanced colorectal neoplasia; MSTF: Multisociety Task Force on Colorectal Cancer; SACN: synchronous advanced colorectal neoplasia; SSP: sessile serrated polyp;