



# Diagnostic accuracy of community pathologists in the interpretation of colorectal polyps

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**Background and aims** Management of patients with endoscopically removed colorectal polyps is generally dependent on pathological evaluation. The aim of this study was to assess the accuracy and clinical impact of pathologic interpretation of colorectal polyps by community pathologists.

**Methods** Two expert gastrointestinal pathologists reviewed the slides of 300 colorectal polyps initially examined by 14 general pathologists. Polyps had been detected by a fecal occult blood test colorectal cancer screening program in Haut-Rhin, a French administrative district.

**Results** Villous histology was overread in 24.8% of cases and high-grade dysplasia in 22.0%. The diagnosis of serrated adenoma was confirmed in 15.7% of cases. The diagnosis of T1 carcinoma was overestimated in seven cases (17.9%) and missed in four. In the screening program, the proportion of correct diagnoses of community pathologists was estimated at 45.3% of polyps, of misclassification without clinical impact at 27.5%, and of misclassification with a theoretical impact on management at 27.2%, leading to over surveillance in 20.3% of polyps and to unnecessary surgical resection in three individuals. Overall, 37.5% of the pathology reports of malignant polyps were complete, presenting all criteria necessary for therapeutic decision making.

## Introduction

Colorectal cancer (CRC) is the second most common cause of death from malignant disease in France and resulted in about 16 000 deaths in 2000 [1]. CRC prevention is possible through the removal of colorectal neoplasia; several studies have shown that CRC incidence is reduced after polypectomy [2–4]. After polypectomy, decisions regarding surgical resection and surveillance intervals are based on pathology findings of the removed specimens. For example, removal of adenomatous polyps requires colonoscopic surveillance, whereas removal of nonadenomatous polyps generally does not. Advanced

**Conclusion** Community pathologists exhibited moderate accuracy for interpreting colorectal polyps, with an impact on patient management for around one out of five individuals. Our results confirm the intrinsic poor reliability of the pathologic interpretation of villous histology and high-grade dysplasia and suggest that these advanced pathologic features should be abandoned for clinical use. They illustrate the need for a clarification of the nomenclature of serrated polyps. *Eur J Gastroenterol Hepatol* 00:000–000 © 2009 Wolters Kluwer Health | Lippincott Williams & Wilkins.

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adenomas justify a 3-year postpolypectomy surveillance interval, whereas nonadvanced adenomas require a 5-year interval. Decisions regarding surgical resection after endoscopic removal of malignant polyps are based on pathologic features and adequacy of endoscopic resection. The accurate pathologic assessment of colorectal polyps is therefore crucial for patient-management decisions. Several studies have showed a poor interobserver agreement for the diagnosis of villous histology and high-grade dysplasia, even between expert pathologists, with moderate accuracy in community practice [5–14]. The impact of such poor-to-moderate diagnostic performance on routine patient management was not quantified. Similarly, few data are available on interobserver agreement and accuracy of pathologic interpretation for serrated polyps [15,16].

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The aim of this study was to assess the accuracy of pathologic interpretation of colorectal polyps by community pathologists and its clinical impact on a population-based CRC screening program with guaiac-based fecal occult blood test (gFOBT).

## Methods

### Study setting

In 2002, France initiated an organized population-based CRC screening program with gFOBT. This study was conducted in the administrative district of the Haut-Rhin in eastern France, one of the 23 pilot areas. The design of the pilot program has been previously described [17]. At the end of May 2006, 2560 colorectal polyps had been detected in 1274 people. Their slides had been examined by the 14 community general pathologists practicing in four private pathology laboratories and two pathology departments in public hospitals in the Haut-Rhin.

### Sampling procedure and organization

The study was conducted on a sample of 300 polyps from the whole cohort of 2560 polyps (11.7%). All serrated adenomas ( $n = 71$ ) and all Tis ( $n = 77$ , one of them was a serrated adenoma) and T1 carcinomas ( $n = 39$ ) were included in the study sample. The other polyps were selected at random ( $n = 114$ ). All available slides of each selected polyp were collected and reviewed by two academic pathologists expert in gastrointestinal pathology. Each expert was blind to the original diagnosis and to the diagnosis given by the other expert. When expert pathologists disagreed, they examined together the slides and gave a final consensual diagnosis. The final 'gold standard' diagnoses were the experts' consensual diagnoses. In addition, the initial pathology reports of all T1 malignant polyps were reviewed.

### Criteria for pathologic classification

All community pathologists attended an educational meeting at the beginning of the screening program and were instructed to use the same classifications and diagnostic criteria. Polyps were classified as hyperplastic polyps or adenomas according to the WHO classification [18]. Adenomas were further classified as serrated or classical. According to percentage of villous elements, classical adenomas were classified as tubular (less than 20% villous elements), tubulovillous (20–80%), and villous (more than 80%). Serrated polyps were reclassified by the two expert pathologists as hyperplastic polyp, sessile serrated adenoma, or traditional serrated adenoma using criteria published in the review of Snover *et al.* [19]. Dysplasia was classified according to the revised Vienna classification of gastrointestinal epithelial neoplasia [20]. In-situ and intramucosal carcinomas [categories 4.2 and 4.4 in the revised Vienna classification and Tis in the tumor-node-metastasis (TNM) classification] were classified as high-grade dysplasia [20,21]. Advanced adenoma was defined as an adenoma  $\geq 10$  mm or with

villous elements greater than 20% or with high-grade dysplasia. Cancer was defined as carcinoma invading at least the submucosa across the muscularis mucosa (category 5 in the revised Vienna classification) [20] and was classified according to the TNM classification [21].

### Clinical impact

The clinical impact of the pathologic interpretation was assessed by group, according to the malignancy of the polyps. In the malignant polyps group, the indication for surgical resection defined in the French guidelines [22] was considered appropriate; briefly, the endoscopic resection was considered sufficient in case of invasive carcinoma if the following criteria were fulfilled: polyp completely excised by the endoscopist and submitted *in toto* for pathological examination, cancer not poorly differentiated, no vascular or lymphatic involvement, and margin  $\geq 1$  mm. In the benign polyps group, the surveillance intervals after polypectomy described in the French guidelines ([www.has-sante.fr](http://www.has-sante.fr)) were considered appropriate; briefly, a 3-year interval was recommended in patients with any advanced adenoma, three or more than three adenomas, or any adenoma and a family history of CRC; a 5-year interval was recommended in all other patients with adenoma, either classical or serrated.

The  $\chi^2$  test was used for statistical analysis. The inter-observer agreement between the two expert pathologists was assessed using  $\kappa$  statistics. The significance threshold was set at 0.05.

## Results

### Study population

Two hundred eighty-eight polyps were removed endoscopically and 12 surgically. The analysis was limited to 297 polyps, because the slides were lost in one case and because of excessive burning of the polyp during the endoscopic resection in two cases. The distributions of the histological types in the whole cohort and the sample are presented in Table 1 and the distributions of the degrees of dysplasia in Table 2. In the sample, the histological type could not be assessed in two cases because of malignant transformation without adenomatous

**Table 1 Distributions of the histological types in the whole cohort (community pathologists' diagnoses) and in the sample (expert pathologists' diagnoses)**

Histological type	Whole cohort, n (%)	Sample, n (%)	P
Adenomatous polyps	1833 (77.4)	192 (65.8)	<0.001
Tubular adenoma	1331 (56.2)	60 (20.5)	<0.001
Tubulovillous adenoma	456 (19.3)	122 (41.8)	<0.001
Villous adenoma	46 (1.9)	10 (3.4)	NS
Serrated polyps	468 (19.8)	95 (32.5)	<0.001
Hyperplastic polyp	393 (16.6)	77 (26.4)	<0.001
Mixed (hyperplastic + tubular)	0 (0)	4 (1.4)	<0.001
Serrated adenoma	75 (3.2)	14 (4.8)	NS
Inflammatory polyps	18 (0.1)	5 (1.7)	NS
Total	2368 (100)	292 (100)	

Serrated adenomas included six traditional and eight sessile serrated adenomas.

**Table 2 Distributions of the degrees of dysplasia in the whole cohort (community pathologists' diagnoses) and in the sample (expert pathologists' diagnoses)**

Degree of dysplasia	Whole cohort, n (%)	Sample, n (%)	P
No dysplasia	643 (25.2)	90 (30.3)	NS
Low grade	1188 (46.6)	62 (20.9)	<0.001
High grade	676 (26.5)	109 (36.7)	<0.001
T1 carcinoma	41 (1.6)	36 (12.1)	<0.001
Total	2548 (100)	297 (100)	

**Table 3 Performances of the community pathologists for the diagnosis of the histological types and degrees of dysplasia in the sample**

	Overall accuracy, % (95% CI)	Sensitivity, % (95% CI)	Specificity, % (95% CI)
<b>Histological type</b>			
Adenomatous polyp	94.9 (92.3–97.4)	95.8 (93.0–98.7)	93.0 (88.0–98.0)
Tubular	73.6 (68.6–78.7)	53.3 (40.7–66.0)	78.9 (73.6–84.1)
Tubulovillous	69.9 (64.6–75.1)	54.9 (46.1–63.7)	80.6 (74.6–86.5)
Villous	95.5 (93.2–97.9)	30.0 (1.6–58.4)	97.9 (96.2–99.6)
>20% villous elements	73.6 (68.6–78.7)	62.9 (54.6–71.1)	82.5 (76.6–88.4)
Serrated polyp	93.5 (90.7–96.3)	92.6 (87.4–97.9)	93.9 (90.6–97.2)
Hyperplastic	79.1 (74.4–83.8)	29.9 (19.6–40.1)	96.7 (94.4–99.1)
Serrated adenoma	77.4 (72.6–82.2)	64.3 (39.2–89.4)	78.1 (73.2–82.9)
<b>Dysplasia</b>			
No dysplasia	79.1 (74.5–83.7)	33.3 (23.6–43.1)	99.0 (97.7–100.4)
Low grade	66.3 (61.0–71.7)	56.5 (44.1–68.8)	68.9 (63.0–74.9)
High grade	82.8 (78.5–87.1)	80.7 (73.3–88.1)	84.0 (78.8–89.3)
T1 carcinoma	96.3 (94.1–98.4)	88.9 (78.6–99.2)	97.3 (95.4–99.3)

CI, confidence interval.

residue and was not specified by the community pathologist in three cases. In the whole cohort database, the histological type was not specified in 192 cases and the degree of dysplasia in 12 cases. The distributions were significantly different between the two groups because of the way the polyps were selected for the study.

**Diagnostic performance**

The performances of the community pathologists for the diagnosis of the histological types and degrees of dysplasia in the study sample are presented in Table 3. As a whole, community pathologists had correctly diagnosed the histological type in 46.9% of polyps [95% confidence interval (CI): 41.2–52.6], the degree of dysplasia in 62.3% (95% CI: 56.8–67.8), and both the histological type and degree of dysplasia in 37.4% (95% CI: 31.9–42.9). The expert pathologists had to examine together 155 slides to arrive at a final consensual diagnosis.

The initial diagnosis of serrated adenoma was confirmed by the experts for 11 out of 70 polyps (15.7%): three traditional and six sessile serrated adenomas and two mixed serrated-tubular adenomas. Fifty-two (74.3%) of the polyps initially diagnosed as serrated adenomas were hyperplastic polyps. The interobserver agreement between the two expert pathologists for the diagnosis of serrated adenoma was moderate ( $\kappa = 0.41$ ).

**Table 4 Performances of the community pathologists for the diagnosis of the histological types and degrees of dysplasia calculated in the whole cohort**

	Positive predictive value %	Negative predictive value %
<b>Histological type</b>		
Adenomatous polyp	97.9	85.6
Tubular	76.3	57.0
Tubulovillous	40.4	88.2
Villous	21.7	98.6
>20% villous elements	49.2	89.2
Serrated polyp	78.9	98.1
Hyperplastic	64.3	87.4
Serrated adenoma	8.8	98.5
<b>Dysplasia</b>		
No dysplasia	91.8	81.5
Low grade	61.3	64.5
High grade	64.5	92.3
T1 carcinoma	82.1	99.8

**Table 5 Benign polyps group: clinical impact according to the polyps' size and the histological types**

Polyps	≥ 10 mm, n (%)	< 10 mm, n (%)	Adenomatous, n (%)	Serrated, n (%)
Correct diagnosis	60 (40.5)	31 (27.4)	65 (39.9)	25 (26.9)
Misclassification without impact	79 (53.4)	16 (14.2)	64 (39.2)	10 (10.7)
Misclassification with impact	9 (6.1)	66 (58.4)	34 (20.9)	58 (62.4)
Over surveillance	9 (6.1)	61 (54.0)	21 (12.9)	56 (60.2)
Under surveillance	0 (0)	5 (4.4)	13 (8.0)	2 (2.2)
Total	148 (100)	113 (100)	163 (100)	93 (100)

The villous elements had been overread by community pathologists in 24.8% of polyps. High-grade dysplasia had been overestimated in 22.0% of polyps and underestimated in 12.8%. The interobserver agreement between the two expert pathologists was moderate for villous histology ( $\kappa = 0.44$ ) and substantial for high-grade dysplasia ( $\kappa = 0.67$ ).

The positive and negative predictive values for the diagnosis of the histological types and degrees of dysplasia calculated for the whole cohort of polyps are presented in Table 4. They were all calculated using Bayes' formula except for T1 carcinoma. For the latter, they were directly calculated using the numbers of the whole cohort and assuming the highly probable hypothesis that all cases of T1 carcinoma and of misclassification of T1 carcinoma had been registered.

**Clinical impact**

In the benign polyps group, the clinical impact varied according to the size of the polyps and their histological types (Table 5). Overall, misclassification had a theoretical clinical impact for 75 benign polyps (28.7%) in 56 people (26.0%). When taking into account the synchronous polyps, the real impact of misclassification involved 52 polyps (19.9%) in 40 people (18.6%). If a 3-year surveillance interval had been attributed to all ≥ 10 mm polyps,

whatever the pathology report, the rates of over surveillance would have been lower than the actual rates, either in the sample (4.7 vs. 6.1%) or in the whole cohort (1.6 vs. 2.5%).

In the malignant polyps group, there was misclassification with a potential impact on the treatment in 11 cases (25.6%) and an actual impact in three (7.0%). In seven cases, the community pathologist had diagnosed an invasive cancer instead of a high-grade dysplasia, leading to potential over treatment. In three cases, the two expert pathologists disagreed initially and had to examine together the slides to come to an agreement on the diagnosis of high-grade dysplasia. Unnecessary surgical resection was actually performed in three individuals. The community pathologists missed four cases of invasive cancer, leading to potential undertreatment. All had been initially diagnosed with in-situ carcinomas, which were consensually interpreted as being invasive cancer by the expert pathologists. All had favorable prognostic features, so that the endoscopic resection was curative.

The overall clinical impact on the screening program was estimated by extrapolation from the sample to the whole cohort. In the latter, the proportion of correct diagnoses of community pathologists was estimated at 45.3% of polyps, of misclassification without clinical impact at 27.5%, and of misclassification with a theoretical impact on management at 27.2% (over surveillance for 20.3% and under surveillance for 6.9%).

#### **Pathology reports of malignant polyps**

When reviewing the pathology reports of 32 malignant polyps, the stage of invasion was specified according to an established classification in 81.3%, the degree of differentiation and the resection margin status in 75.0%, and the presence or absence of angiolymphatic invasion in 43.8%. Overall, 37.5% of the reports were complete with all these criteria specified.

#### **Discussion**

Our results confirm the poor reliability of the pathologic interpretation of villous histology and high-grade dysplasia in colorectal adenomas. They show that the accuracy of community pathologists varied according to the factors evaluated. It was very good for the classification of polyps in adenomatous polyps with a positive predictive value of 97.9%, fair for the diagnosis of malignant polyps and poor for serrated adenomas.

#### **Villous elements**

Their accuracy was only fair for the characterization of adenomatous polyps in tubular, tubulovillous, and villous adenomas. The positive predictive value for adenomas with villous histology was only 49.2%. For the clinician, it would be better to rely on the negative predictive value

(i.e. absence of villous histology), which was much higher (89.2%). The moderate interobserver agreement between our expert pathologists highlights the fact that the percentage of villous elements is not a reliable criterion. Earlier studies have shown the tendency to overread villous elements in community practice [9]. In our screening program, this tendency led to a 27.1% rate of adenomas with villous histology, which is almost three times higher than the maximal 10% rate recommended by the US multi-society task force on CRC [23]. This recommendation was, however, based on a colonoscopy screening series in asymptomatic male American adults and would not be relevant for our series as the advanced neoplasia yield is higher in gFOBT-positive individuals [24]. This recommendation, useful for research studies on colonoscopic screening of asymptomatic adults, is of limited value in routine practice with a 'real world' recruitment because the advanced neoplasia yield varies according to the indication of the colonoscopic procedure [25].

#### **High-grade dysplasia**

There was a similar tendency to overread high-grade dysplasia: the positive predictive value for high-grade dysplasia was only 64.5%. Accordingly, the clinician would better rely on the negative predictive value (i.e. absence of high-grade dysplasia), which was much higher (92.3%). In our screening program, the effect of this overestimation was a high rate of adenomas displaying high-grade dysplasia (36.3%) [17]. There is no benchmark for this rate. Rates were not mentioned in European controlled trials of screening for CRC with gFOBT, except for the British trial, which reported 13.7% [26]. Several earlier studies have demonstrated a poor intraobserver [12] and interobserver agreement for the diagnosis of the degree of dysplasia [5,7,8,11–13], even between highly specialized academic pathologists [12], and high error rates in identification of high-grade dysplasia by community pathologists [9]. Other studies demonstrated that using a broad and simple classification (i.e. high-grade vs. low-grade) improved reliability [6,12]. The community pathologists used this simple classification in our screening program, but despite this their accuracy was only moderate.

#### **Advanced adenoma**

The advanced adenoma is, rather than any adenoma, the more valid surrogate biologic marker for CRC risk and is the primary target of CRC screening [27]. The problem is that its precise definition has not been established and varies among studies [27] and that the two pathologic criteria for the diagnosis of advanced adenomas are, even in expert hands, neither reliable nor reproducible. The problem of the accuracy of the diagnosis of these two pathologic criteria concerns all adenomas, whatever their size, but has a clinical impact only in < 10 mm adenomas as the  $\geq 10$  mm size is by itself an advanced feature. That is why in our sample the rate of misclassified polyps

with a clinical impact was by far higher in the less than 10 mm polyps group (58.4%) than in the  $\geq 10$  mm group (6.1%). In our screening program, the double tendency to overread villous histology and high-grade dysplasia led to a slightly overestimated high rate (23.6%) of colonoscopies with advanced adenoma being the worst prognosis lesion [17]. Of them 83.1% were  $\geq 10$  mm adenomas and 16.9% were defined on pathologic criteria, 9.6% with high-grade dysplasia, 5.5% with villous histology, and 1.8% with both (personal data). If we consider a 20% overestimation of the pathologic criteria, the rate of advanced adenomas should decrease from 23.6 to 22.8%. Several studies have addressed the reproducibility and the accuracy of the diagnosis of villous histology and dysplasia [5–9,11–13]. They all showed that the intraobserver agreement was fair-to-moderate and the interobserver agreement poor-to-moderate, even in expert hands and with simpler classifications. Performances do not improve with time and are not better in recent studies [11–13]. These unanimous results show that these poor performances are intrinsic, because of the measured entity rather than ~~to~~ the measuring tool. The assessment of the advanced pathologic features is subjective. As performances are far from perfect even in expert hands, a quality improvement process is, in our opinion, hopeless. On account of the two pathologic criteria, the current definition of the advanced adenoma is not satisfactory for clinical use, either for the determination of the postpolypectomy surveillance interval (i.e. 3 vs. 5 year) or for the assessment of the yield of screening tools or programs. These two pathologic features should be abandoned for clinical use, either by a modification/simplification of the definition of the advanced adenoma or by the use of other criteria specifically designed for clinical practice. They could favorably be replaced by objective and quantitative criteria, mainly such as the polyps' size and number and accessorially their location, shape, and gross appearance. These criteria remain to be elaborated. For example, if a 3-year surveillance interval had been attributed to all  $\geq 10$  mm polyps in our study, the rate of over surveillance would have been lower than the actual rate obtained taking into account the pathology report. The difference was because of the confusion between hyperplastic polyps and serrated adenomas. Another argument favoring the abandon of these advanced pathologic features in clinical practice is the emerging use of new imaging techniques for CRC screening, such as computed tomography, colonography, or colon capsule endoscopy. These techniques can detect but not remove polyps and do not allow biopsy specimens. The patients are referred for colonoscopy according to macroscopic criteria solely, namely the polyp's size and number. Using the same macroscopic criteria for the assessment of all CRC screening techniques would permit a better comparison of their yield. Likewise, the assessment of the yield of CRC screening programs should better rely on the rate of  $\geq 10$  mm adenomas than on the rate of advanced adenomas.

## Cancer

In seven cases the community pathologist diagnosed an invasive cancer instead of high-grade dysplasia. Conversely, four cancers were missed. The positive predictive value of community pathologists for the diagnosis of malignant polyps was 82.1%. Rex *et al.* [9] found similar high rates (21.7%) of overreading of high-grade dysplasia as invasive cancer. In the same study, the sensitivity of community pathologists for identification of invasive cancer was high (91%) close to our 88.9% sensitivity rate. In another study, there was only moderate agreement between general and expert pathologists with regard to T stage (Tis vs. T1) of malignant polyps [14]. Given the stakes (i.e. decision regarding surgical management), we advocate a systematic review of all malignant polyps by a pathologist with a special interest in gastrointestinal pathology. If we had done that, three people would have avoided unnecessary surgery in our screening program. As agreement between expert pathologists is not 100% with regard to the diagnosis of invasive cancer (three out of seven cases in our study), a dual review is mandatory. All four cancers missed by community pathologists had been initially diagnosed as in-situ carcinoma. Such underreading could be avoided by a systematic review of in-situ and intramucosal carcinomas (categories 4.2 and 4.4 in the revised Vienna classification and Tis in the TNM classification). They accounted for 4.7% of the polyps detected by our screening program.

## Serrated polyps

As in earlier studies, the accuracy of community pathologists was very good for the distinction between adenomatous and serrated polyps [7,9–11]. This accuracy was formerly useful in clinical practice for the distinction between polyps requiring colonoscopic follow-up or not. It is less useful as serrated adenomas have been described. Today the pathologist has to distinguish serrated adenomas, which require the same colonoscopic surveillance as classical adenomas according to French guidelines ([www.has-sante.fr](http://www.has-sante.fr)), from hyperplastic polyps that usually do not require surveillance [19]. Only 15.7% of the diagnoses of serrated adenomas were confirmed and 74.3% were in fact hyperplastic polyps. This tendency of community pathologists to overdiagnose serrated adenomas was probably partly because of the fact that emphasis had been placed on interpretation of these adenomas during initial briefing. These poor results illustrate the great confusion prevailing in the nomenclature and diagnostic criteria of serrated polyps [19]. For the defense of the community pathologists, the nomenclature of serrated adenomas is still evolving with new diagnostic features proposed very recently [28] and the study originated in 2003 at a time when the description of serrated adenomas was recent. Likewise, other authors found a moderate accuracy and interobserver agreement for the diagnosis of serrated polyps [15,16]. Fortunately, serrated adenomas are uncommon and represent 0.6–3.5% of all colorectal polyps [29]. As for

intramucosal cancers, they should be systematically reviewed by expert pathologists. The clinical impact would involve determining the need for colonoscopic surveillance, which would require expert review of 2.8% of the polyps detected in our screening program. Moreover, the feedback of the expert opinion could improve the performances of community pathologists in interpretation of these difficult lesions.

### **Clinical impact**

Our study design allowed us to estimate the frequency of errors in community practice in a population-based setting and to quantify its clinical impact. Misclassification of colorectal polyps by community pathologists led to a theoretical modification of management estimated at 27.2% of polyps in the screening program, slightly lower than the rate observed in the sample. The difference was because of the fact that all serrated adenomas detected by the screening program were included in the study sample so that it constituted a harder to classify group. The rate of 27.2% was an overestimate as it was calculated on a theoretical basis of a single polyp per individual and did not take into account eventual synchronous polyps and their number. When taking them into account in the benign polyps group of the sample, the rate of misclassification with clinical impact decreased from a theoretical 28.7% of polyps to an actual rate of 18.6% of patients. The most frequent modification was over surveillance, which was requested for 20.2% of polyps studied. This high rate of over surveillance has significant financial consequences that should be taken into account when calculating the cost-effectiveness of any CRC screening program.

### **Pathology reports of malignant polyps**

Overall, 37.5% of the pathology reports of malignant polyps were complete, with all criteria specified for judging the need for surgical resection. These criteria include the level of invasion according to an established classification (TNM [21], Haggitt [30], Kikuchi [31], Paris [32]), the distance between the cancer and the resection line, the degree of differentiation and the presence or absence of angiolymphatic invasion [20]. Other studies found the same frequent lack of adequate characterization of malignant polyps in pathology reports [9,14]. The use of proformas has been demonstrated to improve the completeness of information within pathology reports and the communication between clinician and pathologist [33–35]. Such proformas and checklists for the pathology report of malignant polyps have been generated by the Royal College of Pathologists ([www.rcpath.org](http://www.rcpath.org)) and the College of American Pathologists ([www.cap.org](http://www.cap.org)), but may be underutilized and are not available yet in French. The high interobserver variability in the assessment of angiolymphatic invasion limits, however, the value of this measurement for clinical decision making [14,36,37].

### **Terminology**

Another area of weakness was the use of the terms carcinoma *in situ* and intramucosal adenocarcinoma instead of high-grade dysplasia in the pathology reports. This incorrect terminology is used more often than not [9] despite current recommendations [23]. In fact, neither carcinoma *in situ* nor intramucosal adenocarcinoma constitutes cancer of the colon because the neoplastic changes are confined to the mucosa. Avoidance of these terms should help avoid unnecessary surgery as these lesions have zero risk of metastasis [23].

### **Quality assurance**

Considering these areas of weakness and their clinical impact, there is a need for an improvement of practices. The need is all the greater as CRC screening is becoming widespread and organized. A quality assurance process for the pathologic interpretation of colorectal polyps is mandatory in any organized CRC screening program. At the beginning of our screening program, quality of pathologic interpretation was ensured by an educational meeting. The present results show that this was not sufficient. This study was a part of a quality assurance process and feedback of its findings to participants was used to improve practices. In the Danish trial, all adenomas and cancers were interpreted by a single academic pathologist [38]. In the British trial, malignant polyps were reviewed by a single academic pathologist [26]. In the British pilot study, the pathologic interpretation was carried out by specialist gastrointestinal pathologists, with quality assured by circulation of a pertinent slide [39]. The pathologic interpretation (and/or review of slides) of all polyps detected by our screening program by a single academic gastrointestinal pathologist is neither possible nor desirable. In contrast, it would be useful if a minority of polyps were systematically reviewed. Criteria for review would be founded on interpretation difficulties associated with a significant clinical impact. As stated above, we advocate a systematic review of all T1 carcinomas, all adenomas with high-grade dysplasia categories 4.2 and 4.4 in the revised Vienna classification and all serrated adenomas. The workload would be acceptable as they represent 7.6% of all polyps detected by our screening program. Telepathology could facilitate this review, as it has been shown as an efficient method for the assessment of diagnostic reproducibility in various dysplastic lesions of the gastrointestinal tract, including colonic polyps [40,41]. This technology can even be improved with the use of the so-called 'virtual slides' [42]. Another way to improve quality would be to have a pathologist in each pathology laboratory or department, specialized in gastrointestinal pathology and to refer all polyps to this specialist.

In summary, community pathologists exhibited moderate accuracy for interpreting colorectal polyps, with an impact on patient management for around one out of five individuals in this population-based setting. Our results

confirm the intrinsic poor reliability of the pathologic interpretation of villous histology and high-grade dysplasia and suggest that these advanced pathologic features should be abandoned for clinical use. They illustrate the need for a clarification of the nomenclature of serrated polyps and suggest the need for a systematic review of slides of malignant polyps to avoid unnecessary surgery. They illustrate the frequent lack of adequate characterization of malignant polyps and the need for a standardized pathology report for these polyps.

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