Background/Aims: Narrow Band Imaging (NBI) International Colorectal Endoscopic (NICE) and Workgroup Serrated Polyps and Polyposis (WASP) classifications were developed for optical diagnosis of neoplastic and sessile serrated polyps, respectively. Near-focus NBI with NICE combined with WASP criteria for optical diagnosis of colonic polyps has not yet been evaluated. We aimed to compare the accuracy of near-focus NBI (group A) with normal-focus NBI (group B) in real-time optical diagnosis of colorectal polyps using combined NICE and WASP criteria.

Methods: Among 362 patients, 118 with 227 polyps were recruited. Groups A and B included 62 patients with 130 polyps (three lost polyps) and 56 patients with 106 polyps (six lost polyps), respectively. Optical diagnoses were compared with pathological reports.

Results: The accuracy of optical diagnosis of neoplastic polyps in groups A and B was not significantly different (76% vs. 71%, p=0.52). WASP criteria provided all false positive diagnoses of sessile polyps as serrated polyps in 31 (16.2%) patients.

Conclusions: Near-focus NBI was not superior to normal-focus NBI in optical diagnostics of neoplastic polyps using NICE criteria. In our study, WASP classification yielded all false positives in the diagnosis of sessile serrated adenomas/polyps. Routine real-life optical diagnosis of polyps is still unadvisable.

Keywords: Adenomatous polyp; Colonic polyps; Colonoscopy

INTRODUCTION

Colorectal cancer is the third most common cancer with substantial contribution to cancer-related mortality worldwide. Screening colonoscopy can reduce the risk and mortality to approximately 53% to 80%. However, nearly half of detected small polyps are non-neoplastic with a negligible risk of transformation to cancer; therefore, polypectomies of these polyps are unnecessary. Narrow band imaging (NBI) is an image-enhancing technology that utilizes narrow-band light filters to improve visualization of mucosal surface architecture and vascular patterns. Many studies, including multiple meta-analyses, show the efficacy of NBI for the optical diagnosis of polyps, with reported sensitivities of 85% to 92.2%.

The NBI International Colorectal Endoscopic Society has...
Institute, a tertiary health center in affiliation with the Prince
This prospective randomized trial was conducted at the NKC
Patient selection

METHODS

Patient selection
This prospective randomized trial was conducted at the NKC
scheduled for colonoscopy at the NKC Institute from April

Study design and colonoscopy procedure
Randomization codes were generated by a computer using a
Bowel preparation
A split dose of 90 mL was used. A solution of monobasic sodi-

Colonoscopy procedure
All procedures were performed with a high-definition colono-

proposed the NBI International Colorectal Endoscopic (NICE)
criteria to differentiate neoplastic lesions, namely, adenoma and
deep submucosal invasive cancer from hyperplastic polyps.
This classification system showed a good correlation between
the optical and histopathological diagnoses in some pilot stud-
ies by expert endoscopists, while other studies in community
settings showed inferior results. \textsuperscript{3,17,16} Sessile serrated adenomas/
polyps (SSAPs) are difficult to differentiate from hyperplastic
polyps by colonoscopy, even when using NBI and the NICE cri-
tera. \textsuperscript{19-21} A meta-analysis of 10 studies (eight with magnifying
NBI and two with standard NBI) showed a pooled sensitivity
and specificity of 0.6 and 0.75 for optical diagnosis of SSAPs,
respectively. \textsuperscript{22} Endoscopic features of SSAPs, as validated by
international NBI experts, include (1) a cloud-like surface,
(2) indistinct borders, (3) irregular shapes, and (4) dark spots
inside the crypts, with the combination of all four characters
yielding an accuracy of 93%. \textsuperscript{23} The Workgroup Serrated Polyps
and Polyposis (WASP) developed a classification combining
the NICE classification and the criteria for SSAPs to distinguish
hyperplastic polyps from SSAPs, and the WASP criteria signifi-
cantly improved the accuracy of optical diagnosis despite the
use of only two features of SSAPs. \textsuperscript{24} One study evaluated the
accuracy of optical diagnosis of NBI without optic magnifica-
tion using combined NICE and WASP classification as assessed
by non-expert endoscopists and showed moderate accuracy for
the real-time optical diagnosis of colorectal lesions. \textsuperscript{25}

The introduction of a novel dual-focus capability (Olympus
Co., Tokyo, Japan) enables optical magnification of up to 65×
in near-focus (NF) compared with 52× in standard focus (SF). \textsuperscript{26}
Several case series and comparative studies have used SF-NBI
to assess the diagnostic accuracy of available NF-NBI technolo-
gy, \textsuperscript{27-30} which reported high accuracies in series reports and bet-
ter or similar results to SF-NBI in comparative studies. To the
best of our knowledge, no study on NF-NBI has incorporated
the NICE and WASP criteria in the optical diagnosis of colonic
polyps. Therefore, we aimed to compare the accuracy of optical
diagnosis between NF-NBI and SF-NBI by NBI-non-expert en-
doscopists using the combined NICE and WASP criteria.

METHODS

Patient selection
This prospective randomized trial was conducted at the NKC
Institute, a tertiary health center in affiliation with the Prince
of Songkla University. Patients aged 18 to 75 years who were
best image captured and stored on a computer using the Endo-Smart Program ver. 7 (Kainatic Engineering Co., Ltd., Bangkok, Thailand). The polyp size was estimated using the width of the opened biopsy forceps as the reference. The polyp morphology was described as either pedunculated (O-Ip), sessile (O-Ias), or flat (O-IIb). Diminutive polyps were defined as polyps <5 mm. The location, size, number, morphology, and optical diagnosis of the polyps were recorded in a data recording form.

**Polyp characterization**

Optical diagnosis of each polyp was made according to the NICE and WASP classifications. Based on the NICE classification, polyps were classified as type I, hyperplastic; type II, adenomatous or superficial mucosal invasive cancer (depth <1,000 µm); and type III, deep mucosal invasive cancer (depth ≥1,000 µm). For sessile and flat polyps, regardless of the NICE classification, additional assessments were performed based on the WASP classification. SSAPs were diagnosed if two of the following features were present: (1) a clouded surface, (2) indistinctive borders, (3) irregular shapes, and (4) dark spots inside the crypts.

**Pathological polyp evaluation**

All polyps were removed using biopsy forceps, cold snare, or hot snare at the discretion of the attending staff, and the resected specimens were sent for histopathological examination. All histological assessments were performed by a single pathologist (KK) according to the World Health Organization criteria. No validation of the pathologist's accuracy by an independent pathologist was performed in this study.

**Endpoints**

The primary outcome was the performance of NF-NBI compared with SF-NBI in the following: (1) optical diagnosis of neoplastic polyps and (2) differentiation of serrated adenomas from hyperplastic polyps for sessile polyps, compared with histologic evaluation. The performance was assessed by accuracy, sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of NF-NBI compared to SF-NBI.

**Sample size calculation**

The sample size was calculated with the assumption that NF-NBI was 10% superior to SF-NBI. The number of polyps required was 252 in each group in order to detect a difference with an accuracy with a power of 80% at the significance level α=0.05, calculated by using the comparison of two proportions based on the accuracy of SF-NBI=75%.

**Statistical analysis**

Continuous variables are presented as means+standard deviations, and statistical analysis was performed using Student t-test. The discrete variables are presented as percentages. The accuracy, sensitivity, specificity, PPV, and NPV were presented as percentages, and the chi-square test or Fisher exact test were performed for analysis as appropriate. Statistical significance was set at p<0.05. All statistical analysis was conducted using R (ver. 3.6.1, Vienna, Austria).

**Ethical statements**

The study protocol was approved by the Ethics Committee of the Faculty of Medicine, Prince of Songkla University (Registration No. 61355143) and was registered with Clinical Trials.gov (NCT 04831814) on 04/01/2021. This study was conducted in accordance with the principles of the Declaration of Helsinki. Informed consent was obtained from each patient prior to study entry.

**RESULTS**

In total, 362 patients were recruited between April 2019 and January 2020, and 118 of them had polyps on colonoscopy and were eventually randomized into the study groups. A total of 236 polyps were detected in the whole group, but nine polyps (3 of 130 polyps in group A, 6 of 106 polyps in group B) were lost during the retrieval process, leaving only 227 polyps eventually available for pathological assessment. The number of missing polyps was not significantly different between the two groups (p=0.35).

Of the 227 total polyps, 144 (63.4%) of the polyps were adenomas, 79 (34.8%) were hyperplastic polyps, and 4 (1.8%) were cancers according to histological results. There were 191 sessile and flat polyps, but no SSAPs were detected. The most common site of polyps was in the sigmoid colon (30%), and 188 of 227 (82.8%) polyps were diminutive in type. The polyp detection rate and adenoma detection rate for the entire group of 362 patients were 118 of 362 (32.6%) and 86 of 362 (23.8%), respectively.

Sixty-two patients with 130 polyps, including three polyps lost before histologic evaluation, were assigned to group A, and 56 patients with 106 polyps, including six polyps lost before
histologic evaluation, were allocated to group B (Fig. 1). There were no significant differences between the two groups regarding age, sex, indications for colonoscopy, total procedure time, withdrawal time, cecal intubation rate, complication rate, polyp size, morphology, histology, and location (Table 1). The quality of bowel preparation in group A was significantly better than that in group B ($p=0.01$). There were 76 adenomatous polyps and two cancers by histology in group A, and 68 adenomatous polyps and two cancers in group B, but the differences were not statistically significant ($p=0.43$).

**Primary end point**

The accuracy, sensitivity, specificity, PPV, and NPV of NICE in optical diagnosis of neoplastic polyps were 76%, 72%, 81%, 86%, 64%, respectively, in group A, and 71%, 66%, 83%, 90%, 51%, respectively, in group B. The performance of NF-NBI was not better than that of SF-NBI for the optical diagnosis of neoplastic polyps ($p=0.52$, $p=0.45$, $p=0.85$, $p=0.51$, and $p=0.09$, respectively) (Table 2). The NPV in NF-NBI was greater than that in SF-NBI, although the difference was not statistically significant ($p=0.09$).

**Outcome measures according to interobserver variations**

The capability of each endoscopist in optical diagnosis of polyps using the NICE classification (excluding WASP for SSAPs) compared with histological analysis by using Cohen’s K-coefficient were 79.21% (kappa=0.579) for endoscopist I, 64.58% (kappa=0.431) for endoscopist II, 54.55% (kappa=−0.009) for endoscopist III, and 50% (kappa=0.213) for endoscopist IV.

The accuracy of the NICE classification for optical diagnosis of neoplastic polyps in both groups by the endoscopists with greater kappa values (kappa=0.579 and 0.431) was 76%. This was significantly greater than the 57% score by the endoscopists with lower kappa values (kappa=0.0213 and -0.0009) ($p=0.007$). The accuracy of the NICE classification in the optical diagnosis of neoplastic polyps by the endoscopists with higher kappa values was 79% in group A, and was greater than the 71% accuracy in group B, however the difference was not significant ($p=0.25$) (Supplementary Table 1), whereas the accuracy of optical diagnosis using the NICE classification for neoplastic polyps by the endoscopists with lower kappa values was 55% in group A, which was lower than the 60% accuracy in group B, but the difference failed to reach statistical significance ($p=0.57$) (Supplementary Table 2).

The sensitivity and NPV of using the NICE classification in predicting neoplastic polyps of both groups by the endoscopists with higher kappa values were 72% and 62%, which were significantly higher than the sensitivity and NPVs of 48% and 49%, respectively, by the endoscopists with lower kappa values ($p=0.002$ and $p=0.004$, respectively), but the specificity and PPV were not significantly different between the two groups of endoscopists, namely 83% and 88% for the endoscopists with...
higher kappa compared with 77% and 82% for the endoscopists with lower kappa; \( p=0.207 \) and \( p=0.228 \), respectively.

The sensitivity, specificity, PPV, and NPV using the NICE classification in predicting neoplastic polyps by the endoscopists with higher kappa values were 75%, 86%, 90%, and 67% in group A, respectively, and 65%, 83%, 89%, and 54% in group B, respectively, with no significant difference \( (p=0.01, p=0.01, p=0.01, \text{and} \ p=0.01) \). The sensitivity, specificity, PPV, and NPV using the NICE classification in predicting neoplastic polyps by the endoscopists with lower kappa values were 41%, 80%, 78%, and 44% in group A, respectively, and 39%, 67%, 88%, and 29% in group B, respectively. The sensitivity in group A was significantly lower than that in group B \( (p=0.023) \). In contrast, the NPV of 44% in group A was significantly higher than that of 29% in group B \( (p=0.039) \); however, there were no significant differences in specificity and PPV between the two groups \( (p=0.054 \text{and} \ p=0.090) \).

### Table 1. Baseline characteristics, colonoscopic procedure details and polyp's characteristics of groups A and B

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Near-focus ( (n=62) ) (group A)</th>
<th>Normal-focus ( (n=56) ) (group B)</th>
<th>( p )-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>59.3±8.7</td>
<td>60±8</td>
<td>0.63</td>
</tr>
<tr>
<td>Sex (male/female)</td>
<td>40/22</td>
<td>34/22</td>
<td>0.82</td>
</tr>
<tr>
<td>Indication</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRC screening</td>
<td>38 (61.3)</td>
<td>29 (51.8)</td>
<td>0.56</td>
</tr>
<tr>
<td>Diagnosis</td>
<td>24 (38.7)</td>
<td>27 (48.2)</td>
<td></td>
</tr>
<tr>
<td>BBPS (mean)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>0 (0)</td>
<td>2 (3.6)</td>
<td>0.01</td>
</tr>
<tr>
<td>7</td>
<td>1 (1.6)</td>
<td>0 (0)</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>0 (0)</td>
<td>4 (7.1)</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>61 (98.4)</td>
<td>50 (89.3)</td>
<td></td>
</tr>
<tr>
<td>Total procedure time (min)</td>
<td>52.9±22</td>
<td>54.5±27.3</td>
<td>0.73</td>
</tr>
<tr>
<td>Withdrawal time (min)</td>
<td>19.6±11.3</td>
<td>24.2±20.9</td>
<td>0.13</td>
</tr>
<tr>
<td>Cecal intubation</td>
<td>59 (95.2)</td>
<td>52 (92.9)</td>
<td>0.71</td>
</tr>
<tr>
<td>Complications</td>
<td>0 (0)</td>
<td>1 (1.8)</td>
<td>0.48</td>
</tr>
<tr>
<td>Polyp number(^a)</td>
<td>127</td>
<td>100</td>
<td>0.13</td>
</tr>
<tr>
<td>Polyp size (mm)</td>
<td>3.8±2.1</td>
<td>4.6±5.2</td>
<td>0.32</td>
</tr>
<tr>
<td>Polyp morphology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sessile</td>
<td>113 (89.0)</td>
<td>82 (82.0)</td>
<td>0.31</td>
</tr>
<tr>
<td>Pedunculated</td>
<td>12 (9.4)</td>
<td>17 (17.0)</td>
<td></td>
</tr>
<tr>
<td>Flat</td>
<td>2 (1.6)</td>
<td>1 (1.0)</td>
<td></td>
</tr>
<tr>
<td>Polyp location</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cecum</td>
<td>10 (7.9)</td>
<td>11 (11.0)</td>
<td>0.65</td>
</tr>
<tr>
<td>Ascending colon</td>
<td>23 (18.1)</td>
<td>14 (14.0)</td>
<td></td>
</tr>
<tr>
<td>Transverse colon</td>
<td>24 (18.9)</td>
<td>16 (16.0)</td>
<td></td>
</tr>
<tr>
<td>Descending colon</td>
<td>18 (14.2)</td>
<td>17 (17.0)</td>
<td></td>
</tr>
<tr>
<td>Sigmoid colon</td>
<td>35 (27.6)</td>
<td>33 (33.0)</td>
<td></td>
</tr>
<tr>
<td>Rectum</td>
<td>17 (13.4)</td>
<td>9 (9.0)</td>
<td></td>
</tr>
<tr>
<td>Histopathology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hyperplastic</td>
<td>49 (38.6)</td>
<td>30 (30.0)</td>
<td>0.43</td>
</tr>
<tr>
<td>Adenomatous</td>
<td>76 (59.8)</td>
<td>68 (68.0)</td>
<td></td>
</tr>
<tr>
<td>Cancer</td>
<td>2 (2.4)</td>
<td>2 (2.0)</td>
<td></td>
</tr>
</tbody>
</table>

Values are presented as mean±standard deviation or number (%). CRC, colorectal cancer; BBPS, Boston bowel preparation score. 

\(^{a}\)Available for histologic assessment.

For diminutive polyps

There were no statistical differences in accuracy, sensitivity, specificity, PPV, and NPV in the optical diagnosis of diminutive neoplastic polyps between groups A and B \( (Table \ 3) \). When
performance was assessed by comparing both groups with both diminutive groups, the accuracy, sensitivity, specificity, PPV, and NPV of using the NICE classification in predicting neoplastic polyps were 74%, 69%, 82%, 88%, and 58% for the whole group and were 68%, 59%, 82%, 82%, and 58% for the diminutive group, respectively; however, the differences were not significant (p=0.44, p=0.19, p=1.00, p=0.32, and p=1.00, respectively).

**Outcome of WASP criteria in sessile polyps**

In 191 sessile and flat polyps, the WASP criteria classified polyps as serrated polyps in 31 (16.2%) cases; however, histology did not confirm the diagnosis in all 31 polyps. Pathological examination of polyps classified serrated polyps according to the WASP criteria revealed hyperplastic polyps in 11 cases and adenomatous polyps in 20 cases. In group A, the WASP criteria falsely diagnosed 22.5% (25 out of 111 sessile or flat polyps) SSAPs, whereas in group B, the WASP criteria falsely diagnosed 7.5% (6 out of 80 sessile or flat polyps) SSAPs, and the difference was statistically significant (p=0.0285). In group A, nine of 59 (15.3%) NICE I were designated as SSAPs using the WASP criteria and 16 of 50 (32%) NICE II were designated as SSAPs using the WASP criteria and 4 of 31 (12.9%) NICE II were designated as SSAPs using

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**Table 2. Accuracy, sensitivity, specificity, PPV and NPV of NICE criteria in groups A and B**

<table>
<thead>
<tr>
<th>The whole group</th>
<th>Near-focus (n=127) (group A)</th>
<th>95% CI</th>
<th>Normal-focus (n=100) (group B)</th>
<th>95% CI</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neoplastic (n=149)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accuracy</td>
<td>79</td>
<td>67–83</td>
<td>70</td>
<td>61–80</td>
<td>0.52</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>76</td>
<td>61–82</td>
<td>71</td>
<td>53–77</td>
<td>0.45</td>
</tr>
<tr>
<td>Specificity</td>
<td>81</td>
<td>67–91</td>
<td>83</td>
<td>65–94</td>
<td>0.85</td>
</tr>
<tr>
<td>PPV</td>
<td>86</td>
<td>76–94</td>
<td>90</td>
<td>79–97</td>
<td>0.51</td>
</tr>
<tr>
<td>NPV</td>
<td>64</td>
<td>51–76</td>
<td>51</td>
<td>36–66</td>
<td>0.09</td>
</tr>
<tr>
<td>Hyperplastic polyp (n=78)</td>
<td>48</td>
<td>67–83</td>
<td>30</td>
<td>61–80</td>
<td>0.52</td>
</tr>
<tr>
<td>Accuracy</td>
<td>76</td>
<td>61–82</td>
<td>71</td>
<td>65–94</td>
<td>0.85</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>81</td>
<td>67–91</td>
<td>83</td>
<td>53–77</td>
<td>0.45</td>
</tr>
<tr>
<td>Specificity</td>
<td>72</td>
<td>51–76</td>
<td>66</td>
<td>36–66</td>
<td>0.09</td>
</tr>
<tr>
<td>PPV</td>
<td>64</td>
<td>76–94</td>
<td>90</td>
<td>79–97</td>
<td>0.51</td>
</tr>
<tr>
<td>NPV</td>
<td>86</td>
<td>51–76</td>
<td>51</td>
<td>36–66</td>
<td>0.09</td>
</tr>
</tbody>
</table>

Values are presented as number (%).

PPV, positive predictive value; NPV, negative predictive value; NICE, Narrow Band Imaging International Colorectal Endoscopic; CI, confidence interval.

**Table 3. Accuracy, sensitivity, specificity, PPV and NPV by NICE criteria in the polyps ≤5 mm**

<table>
<thead>
<tr>
<th>The diminutive group</th>
<th>Near-focus (n=109) (group A)</th>
<th>95% CI</th>
<th>Normal-focus (n=78) (group B)</th>
<th>95% CI</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neoplastic (n=110)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accuracy</td>
<td>61</td>
<td>62–79</td>
<td>49</td>
<td>52–74</td>
<td>0.29</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>72</td>
<td>51–76</td>
<td>64</td>
<td>38–67</td>
<td>0.15</td>
</tr>
<tr>
<td>Specificity</td>
<td>64</td>
<td>67–91</td>
<td>53</td>
<td>64–94</td>
<td>0.85</td>
</tr>
<tr>
<td>PPV</td>
<td>81</td>
<td>67–91</td>
<td>83</td>
<td>66–95</td>
<td>0.71</td>
</tr>
<tr>
<td>NPV</td>
<td>64</td>
<td>51–76</td>
<td>51</td>
<td>36–66</td>
<td>0.09</td>
</tr>
<tr>
<td>Hyperplastic polyp (n=77)</td>
<td>48</td>
<td>62–79</td>
<td>29</td>
<td>52–75</td>
<td>0.29</td>
</tr>
<tr>
<td>Accuracy</td>
<td>72</td>
<td>62–79</td>
<td>64</td>
<td>52–75</td>
<td>0.29</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>81</td>
<td>67–91</td>
<td>53</td>
<td>64–94</td>
<td>0.85</td>
</tr>
<tr>
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<td>64</td>
<td>51–76</td>
<td>64</td>
<td>38–67</td>
<td>0.15</td>
</tr>
<tr>
<td>PPV</td>
<td>64</td>
<td>51–76</td>
<td>51</td>
<td>66–95</td>
<td>0.71</td>
</tr>
<tr>
<td>NPV</td>
<td>72</td>
<td>62–79</td>
<td>64</td>
<td>52–75</td>
<td>0.29</td>
</tr>
</tbody>
</table>

Values are presented as number (%).

PPV, positive predictive value; NPV, negative predictive value; NICE, Narrow Band Imaging International Colorectal Endoscopic; CI, confidence interval.

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the WASP criteria, and the difference between NICE I and NICE II was not statistically significant \((p=0.39)\). There were no differences in false diagnosis rates between NICE I and NICE II in group A compared with group B \((p=0.11\) and 0.20, respectively). Of the 31 polyps classified as serrated polyps according to the WASP criteria, 25 polyps had two features and six polyps had four features of SSAPs.

**Optical diagnosis missed classification**

NICE I classification misclassified adenomatous polyps as hyperplastic polyps in 20 (32.8%) in group A and 24 (49.0%) patients in group B, and one cancer as hyperplastic polyps (1.6%) in group A \((p=0.16)\) (Table 4).

NICE II classification misclassified hyperplastic polyps as adenomatous polyps in nine (14.5%) polyps in group A and five (10.6%) polyps in group B \((p=0.76)\).

NICE III classification misclassified three adenomatous polyps as malignant lesions in group A and misclassified two adenomatous polyps as malignant lesions in group B. There was no statistically significant difference between the two groups \((p=0.82)\).

**Complications**

Post-polypectomy bleeding requiring the application of hemostatic clips occurred in one patient in group B, and the complication rate was similar between the two groups \((p=0.97)\).

**DISCUSSION**

Preliminary analysis in our study showed that the diagnostic accuracy of NF-NBI was not significantly higher than that of SF-NBI (76% vs. 71%) in distinguishing neoplastic and non-neoplastic polyps based on the NICE criteria by the non-expert endoscopists, but findings must be interpreted with caution as we recruited patients with polyps of less than half the calculated sample size, so this may be underpowered to detect the difference. The efficacy of NF-NBI in the optical diagnosis of polyps has been reported in multiple studies, with variable results. Two series reports from academic centers showed a high accuracy in NF-NBI; one report of 63 polyps in 55 patients showed that combination NF-NBI with acetic acid had 85.5% accuracy in the prediction of polyp histology when the confidence in optical diagnosis of the endoscopists was high; another report using NF-NBI with a transparent cap combined with digital magnification of 164 polyps in 87 patients with an overall accuracy of 97% if the optical diagnosis was made with high confidence. In comparative studies, one prospective multi-center randomized study required all participating endoscopists trained for NBI to attain 90% accuracy prior to the study and compared NF-NBI with SF-NBI (180 series) and showed that NF-NBI yielded a higher confidence optical diagnosis than did SF-NBI (85.1% vs. 72.6%). Another series study comparing white light, SF-NBI, and NF-NBI sequentially in the same patient demonstrated that NF-NBI improved accuracy more than SF-NBI, whereas another study reported similar accuracy of NF-NBI (79%) compared of SF-NBI (78%) in the optical diagnosis of colorectal polyps, despite prior training of endoscopists to attain 90% accuracy. Our study showed an accuracy of 76% for NF-NBI in the optical diagnosis of neoplastic polyps that was comparable to that reported by Wallace et al., but lower than that reported by Hewett et al. (89%) using SF-NBI. No formal training for endoscopists was required in our study, and the endoscopists relied on the color image chart of the NICE criteria as a reference. The NPV of 51% to 64% reported in our study was below the 90% Preservation and Incorporation of Valuable endoscopic Innovations, as recommended by American Society for Gastrointestinal Endoscopy as an acceptable capability to implement optical diagnosis. We did not assess confidence level in optical diagnosis; a high-confidence optical diagnosis may have improved the

**Table 4. Optical diagnostic accuracy of polyps by NICE classification in groups A and B**

<table>
<thead>
<tr>
<th></th>
<th>Hyperplastic polyp</th>
<th>Adenomatous polyp</th>
<th>Deep invasive cancer</th>
<th>(p)-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group A</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NICE I ((n=61))</td>
<td>40 (65.6)</td>
<td>20 (32.8)</td>
<td>1 (1.6)</td>
<td>0.16</td>
</tr>
<tr>
<td>NICE II ((n=62))</td>
<td>25 (51.0)</td>
<td>49 (96.0)</td>
<td>0 (0)</td>
<td>0.00</td>
</tr>
<tr>
<td>NICE III ((n=4))</td>
<td>0 (0)</td>
<td>3 (75.0)</td>
<td>1 (25.0)</td>
<td>0.82</td>
</tr>
<tr>
<td><strong>Group B</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NICE I ((n=49))</td>
<td>5 (10.6)</td>
<td>42 (89.4)</td>
<td>0 (0)</td>
<td>0.76</td>
</tr>
<tr>
<td>NICE II ((n=47))</td>
<td>0 (0)</td>
<td>2 (50.0)</td>
<td>2 (50.0)</td>
<td>0.82</td>
</tr>
<tr>
<td>NICE III ((n=4))</td>
<td>0 (0)</td>
<td>2 (50.0)</td>
<td>2 (50.0)</td>
<td>0.82</td>
</tr>
</tbody>
</table>

NICE, Narrow Band Imaging International Colorectal Endoscopic.
outcomes of this study.27-30

This study showed no difference between NF-NBI and SF-NBI in assessing diminutive polyps ≤5 mm compared with those >5 mm; however, the number of polyps >5 mm was low. In one study, NF-NBI performance was better in diminutive polyps ≤5 mm, with an accuracy of 89% and NPV of 96% when the optical diagnosis was made with high confidence.28 In contrast, another retrospective study by Hattori et al.36 using NBI with magnification showed that a NICE I optical diagnosis for small polyps ≤1 cm misclassified 20% of adenomatous polyps and 42% of diminutive adenomas as hyperplastic polyps.

The accuracy of endoscopists with high capability (higher kappa) was superior to that of endoscopists with lower capability (lower kappa), implying that the skill of the endoscopist contributes to the accuracy in our study, which is in line with the findings of one meta-analysis.34 However, the number of cases performed by endoscopists with lower kappa values was low. The Detect Inspect Characterise Resect and Discard 2 study that used NICE criteria in non-academic centers showed a sensitivity of 83% for the presence of adenomas;3 in contrast to our study, endoscopist expertise in the Detect Inspect Characterise Resect and Discard 2 study did not improve performance.

Histologic and optical diagnostic discrepancies have been reported to vary from 3.4% to 19.3%.3,28 We did not assess the accuracy of our pathologists; therefore, the effect on the outcome due to variation in pathological diagnosis accuracy could not be assessed.

The W ASP criteria provide all false optical diagnoses for SSAPs. In this study, the W ASP criteria were applied to sessile and flat polyps, regardless of NICE stratification. For NICE I lesions, the W ASP criteria provided fewer false positives than NICE II in both groups A and B, although the differences were not statistically significant. The W ASP criteria to detect SSAPs for non-expert endoscopists without prior training were unreliable in this study, and NF-NBI did not provide additional advantages. In our study, only two of the four W ASP criteria were used for the diagnosis of SSAPs, while one study that validated the NBI for SSAPs using all four features showed an accuracy of 93%;23 however, in our study, 25 out of 31 polyps had only two features, which may account for the low accuracy using the W ASP criteria. Surprisingly, NF-NBI led to significantly more false positives (25/111) than SF-NBI (6/80) did. This may be due to the narrow focal length of NF-NBI compared to the longer focal length in SF-NBI and that no measures to stabilize

the distance from the tip of the endoscope to the polyp were taken, leading to a more blurred margin and/or blurred surface in NF-NBI than in SF-NBI, which may contribute to more false positives in the NF-NBI group. Further studies with a larger number of polyps and prior training of the endoscopists with measures to stabilize the distance between the endoscope and polyp, as well as using all four features of the W ASP criteria, may clarify the role of the W ASP criteria in using NF-NBI in differentiating SSAPs from hyperplastic polyps.

There were some limitations in our study as follows: (1) the inadequate sample size, as this was a preliminary analysis, (2) the lack of assessment of endoscopist confidence in optical diagnosis that may alter the outcome in our study, (3) the lack of prior training and assessment of endoscopists participating in the study, (4) the small number of polyps included in the assessment of W ASP criteria, (5) the lack of validation of the accuracy of pathological reports of sessile serrated polyps, and (6) the lack of measures to maintain constant focal length from the tip of the endoscope to the polyp that may affect the image sharpness of NF-NBI.

In conclusion, our preliminary data showed that NF-NBI was not superior to SF-NBI in the optical diagnosis of polyps using the NICE criteria. The W ASP classification yielded all false positives for the diagnosis of SSAPs in our study. With the current capability of image-enhancing technology, the routine use of optical diagnosis of polyps in real-life practice is still unadvisable.

Supplementary Material

Supplementary Table 1. Accuracy, sensitivity, specificity, PPV and NPV by NICE criteria of the endoscopists with higher Kappa in optical diagnosis of polyps.

Supplementary Table 2. Accuracy, sensitivity, specificity, PPV and NPV by NICE criteria of the endoscopists with lower Kappa in optical diagnosis of polyps.

Supplementary materials related to this article can be found online at https://doi.org/10.5946/ce.2022.048.

Conflicts of Interest

The authors have no potential conflicts of interest.

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Author Contributions

Conceptualization: NC, NN, BO; Data curation: NC, NN, TP, JS, KK, BO; Formal analysis: NC, NN, BO; Investigation: NC, NN, TP, JS, KK, BO; Methodology: NC, NN, BO; Project administration: NC, NN, Supervision: BO; Writing-original draft: NC, NN, BO; Writing-review & editing: all authors.

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