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Effectiveness of Narrow Band Imaging Technique in Evaluation of Upper and Lower Gastro-Intestinal Surgical Lesions

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Abstract

Introduction: Narrow Band Imaging has revolutionized Gastro-Intestinal endoscopy, offering unparalleled advantages in early detection, accurate characterization, and surgical precision. Its widespread adoption has demonstrably improved patient outcomes and transformed the way we diagnose and manage Gastro-Intestinal diseases. While limitations exist, ongoing research and development promise further advancements in Narrow Band Imaging technology, ensuring its continued reign as a cornerstone of Gastro-Intestinal care.

Aims of the study: To determine if Narrow Band Imaging improves the accuracy of evaluating upper and lower Gastro-Intestinal surgical lesions, potentially reducing biopsies and optimizing surgical planning.

Objective of the study: To Study the Effectiveness of the Narrow Band Imaging Technique in the evaluation of Upper and Lower Gastro-Intestinal Surgical Lesions

Material and Methods

Study Design: A Quasi-Experimental Study.

Study Site: The present study was conducted in Surgery wards and Outpatient department in the Tertiary care hospital.

Study Population: All patients coming with upper and lower gastrointestinal tract complaints to tertiary care center

Study Duration: The study was conducted for 18 months.

Sampling Method: The sample size is determined by the Complete Enumeration method.

Sample Size: A total of 400 patients (300 esophagogastroduodenoscopy and 100 for colonoscopy) were considered and studied with consideration of exclusion and inclusion criteria, All the relevant information was recorded in case record form (CRF).

Result: Total 400 patients, the data reflects the need for colonoscopy screening across all age groups, particularly for younger adults presenting with functional bowel symptoms and for older adults at increased risk for colorectal neoplasms. Esophagogastroduodenoscopy (OGD) is the most commonly performed endoscopic procedure. Excellent visualisation of the oesophagus, gastro-oesophageal junction, stomach, duodenal bulb and second part of the duodenum can be obtained.

Discussion: Patients in the 46-60 years age group made up 25% of the sample, a group more likely to present with chronic gastrointestinal conditions like gastritis or peptic ulcer disease. Narrow band imaging has shown efficacy in detecting gastric intestinal metaplasia (GIM) and other precancerous lesions.

Keywords: Endoscopic Procedures, Colonoscopy, Narrow-Band Imaging, Gastrointestinal Tract, Morbidity

Introduction

Narrow Band Imaging is an optical imaging technology that enhances the visibility of vessels and other tissue on the mucosal surface. Narrow Band Imaging was the first narrowed-spectrum technology commercialized, and it is based on the penetration properties of light.

Narrow Band Imaging utilizes red-green-and-blue filters to modify White Light endoscopy (WLE): the blue light filter (400–430 nm) highlights the capillaries in the superficial mucosa through mean peak absorption of hemoglobin (415 nm), while the green light filter (525–555 nm) penetrates deeper into the mucosa. This results in greater clarity of mucosal surface structures due to the increased contrast between mucosa and superficial vessels, capillaries on the mucosal surface are displayed in brown, and veins in the submucosa are displayed in cyan on the monitor. The normal vascular pattern consists of a regular mucosal capillary network that is altered during the transition of premalignant to malignant lesions, where angiogenesis is critical, and a hyper-proliferative vascular state is observed.

The most important indication for narrow-band imaging throughout the gastrointestinal tract is the early detection of cancers or dysplastic lesions, as narrow-band imaging enables endoscopists to differentiate potentially malignant mucosa from normal mucosa.

Aim of the study

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Sampling Method: The sample size is determined by the Complete Enumeration method.

Sample Size: A total of 400 patients (300 esophagogastroduodenoscopy and 100 for colonoscopy) were considered and studied with consideration of exclusion and inclusion criteria, All the relevant information was recorded in case record form (CRF).

Inclusion criteria

- 10–90-year-old patients coming with complaints of upper and lower gastro-intestinal tract which require endoscopic evaluation
- Eligible for undergoing endoscopic procedures (Esophagogastroduodenoscopy or colonoscopy)
- Patients willing for and giving consent for the procedure

Exclusion criteria

- Patients not willing to participate in the study
- Uncontrolled medical conditions contraindicating endoscopy.
- Patients below 10 and above 90 years of age

Result

Table 1: Age-Wise Distribution of Study Participants. (OGD)

Sn.	Age Groups	Frequency	Percentage
1	18-45 years	173	58%
2	46-60 years	76	25%
3	> 60 years	51	17%
Total		300	100%

The table shows the age-wise distribution of study participants. Here's a breakdown of the data:

- Age group 18-45 years: This group has the highest number of participants (173), representing 58% of the total sample.
- Age group 46-60 years: This group has 76 participants, which is 25% of the total sample.
- Age group >60 years: This group has 51 participants, representing 17% of the total sample.

Figure 1: Age-Wise Distribution of Study Participants. (Oesophagogastroduodenoscopy)

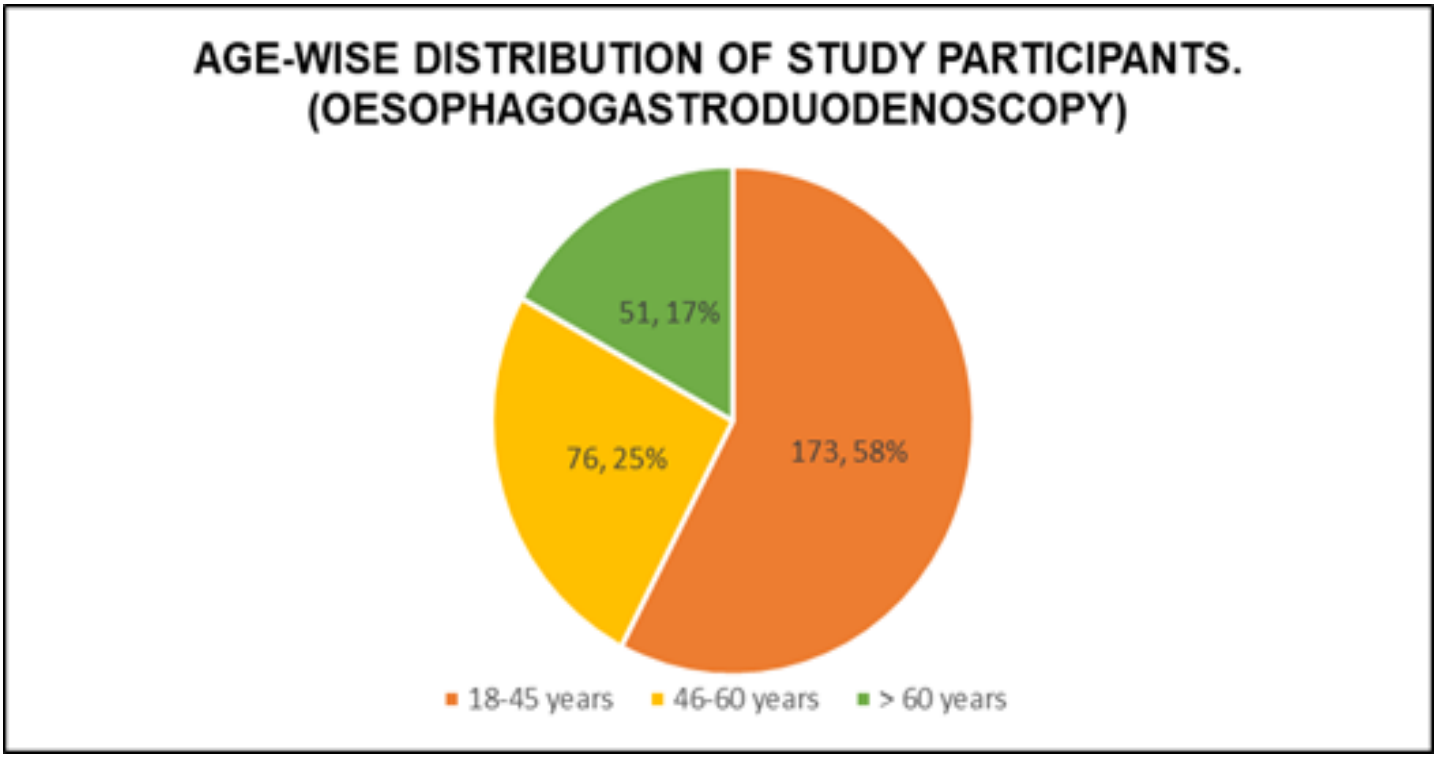

Table 2: Age-Wise Distribution of Study Participants. (Colonoscopy)

Sn.	Age Groups	Number	Frequency
1	18-45 years	56	56%
2	46-60 years	22	22%
3	> 60 years	22	22%
Total		100	100%

The table shows the age-wise distribution of study participants who underwent colonoscopy examinations. Here's a breakdown of the data:

- Age group 18-45 years: This group has the highest number of participants (56), representing 56% of the total sample.
- Age group 46-60 years: This group has 22 participants, which is 22% of the total sample.
- Age group >60 years: This group has 22 participants, representing 22% of the total sample.

Figure 2: Age-Wise Distribution of Study Participants. (Colonoscopy)

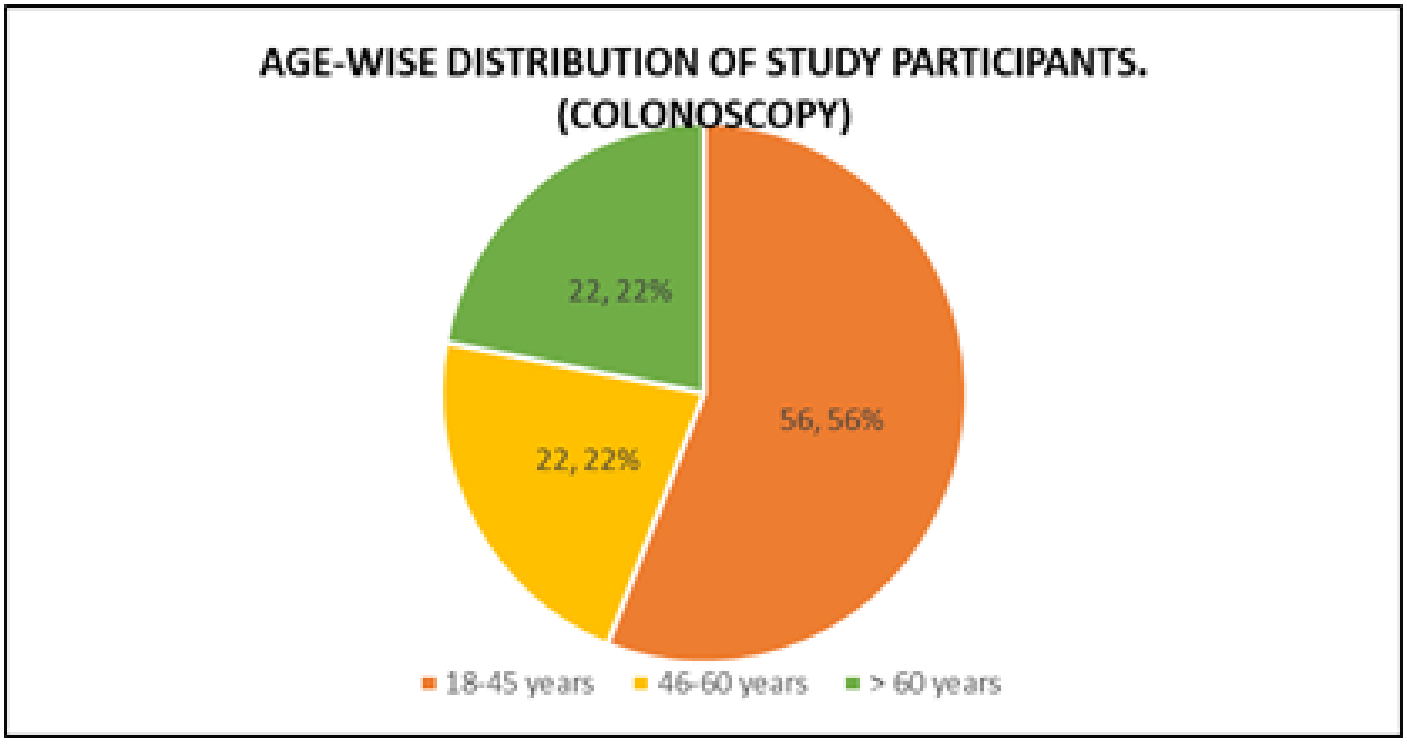

Table 3: Distribution of Patients According To Findings in Oesophagogastroduodenoscopy Procedure (By White Light Endoscopy and Narrow Band Imaging)

Sn.	Type of Lesions	White Light Endoscopy (In Numbers)	Narrow Band Imaging Endoscopy (In Numbers)	Histopathology Correlation
1	Benign Lesions	26	20	15
2	Premalignant Lesions	5	11	12
3	Malignant Lesions	26	26	27

The study findings presented a comparison between White Light Endoscopy (WLE), Narrow Band Imaging Endoscopy (NBI), and histopathological correlation for different types of lesions.

For white light endoscopy:

- 26 patients had probable benign lesions.
- 05 patients had suspicious premalignant lesions.
- 26 patients had suspicious malignant lesions.

For narrow-band endoscopy:

- 20 patients had probable benign lesions.
- 11 patients had suspicious premalignant lesions.
- 26 patients had suspicious malignant lesions.
- Histopathological correlation:
- 15 patients had benign lesions
- 12 patients had premalignant lesions

- 17 had malignant lesions

Figure 3: Distribution of Lesions According To Findings in Oesophagogastroduodenoscopy Procedure

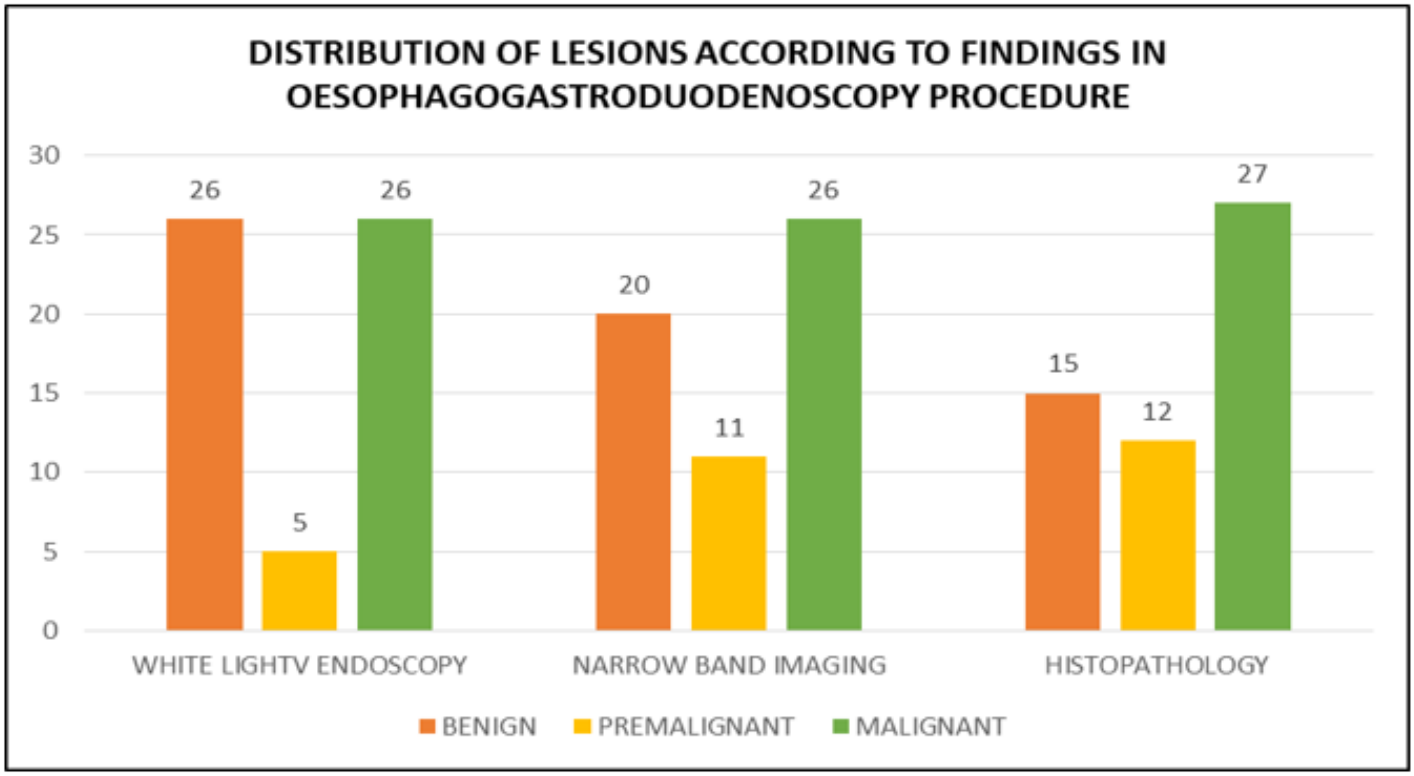

Table 4: Distribution of Patients According To Findings in Colonoscopy Procedure (By White Light Endoscopy and Narrow Band Endoscopy)

Sn.	Type of Lesions	White Light Endoscopy (In Numbers)	Narrow Band Imaging Endoscopy (In Numbers)	Histopathology Correlation
1	Benign Lesions	22	15	13
2	Premalignant Lesions	1	8	9
3	Malignant Lesions	18	18	18

The comparison between White Light Endoscopy (WLE), Narrow Band Imaging Endoscopy (NBI), and histopathological correlation for different types of lesions is as follows:

For white light endoscopy:

- 22 patients had probable benign lesions.
- 01 patients had suspicious premalignant lesions.
- 18 patients had suspicious malignant lesions.

For narrow-band imaging endoscopy:

- 15 patients had probable benign lesions.
- 08 patients had suspicious premalignant lesions.
- 18 patients had suspicious malignant lesions.

Histopathological correlation of lesions:

- 13 patients had benign lesions
- 09 patients had premalignant lesions
- 18 patients had malignant lesions

Figure 4: Distribution of Patients According To Findings in Colonoscopy Procedure (By White Light Endoscopy and Narrow Band Imaging Endoscopy)

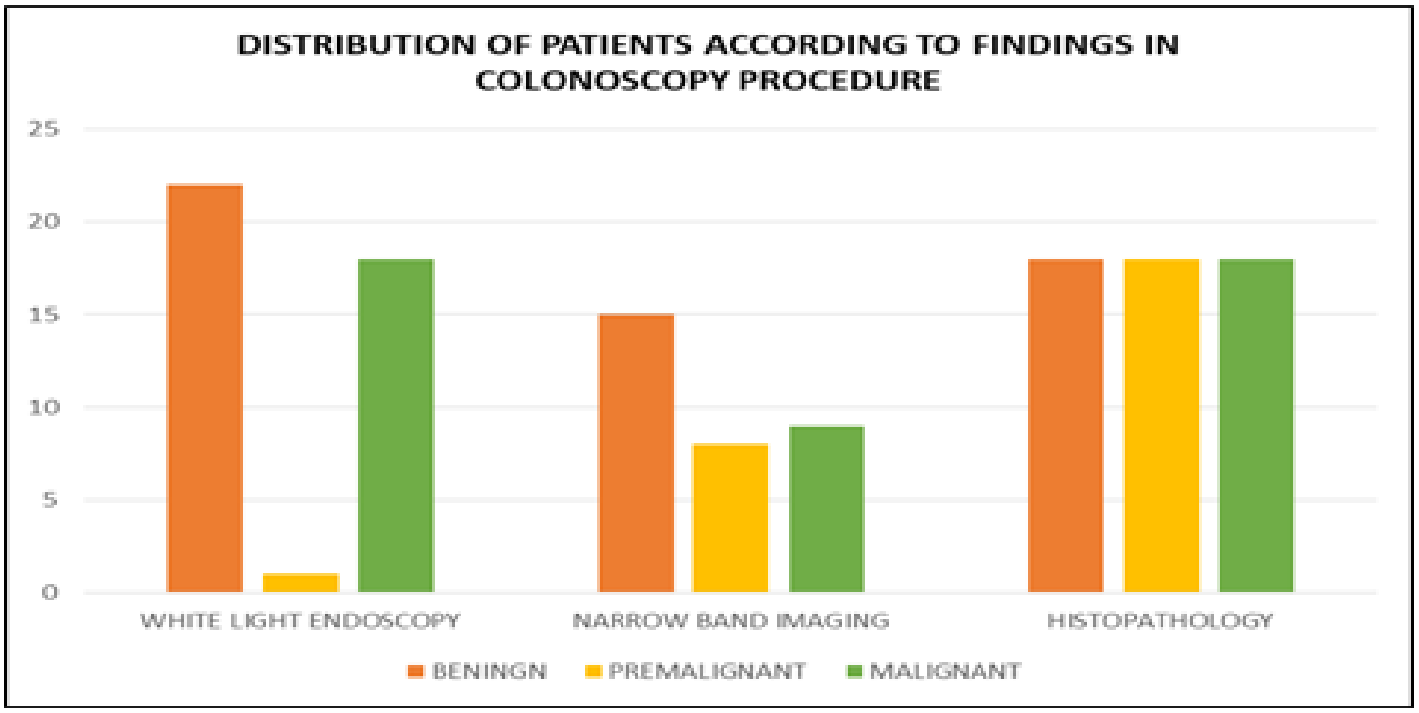

Table 5: Comparison of Patients According To Findings in OGD Procedure (By White Light Endoscopy Compared With Histopathology Reports)

Type of Lesions		White Light Endoscopy (In Numbers)	Histopathology Correlation	Kappa Value
1	Benign Lesions	26	15	0.51
2	Premalignant Lesions	5	12	
3	Malignant Lesions	26	27	

The agreement between endoscopic findings and histopathological confirmation was analysed using Cohen's Kappa coefficient.

Endoscopy classified the subjects into three categories: benign, premalignant, and malignant.

Table 6: Comparison of Patients According To Findings in Oesophagogastroduodenoscopy Procedure (By Narrow Band Imaging Endoscopy Compared With Histopathology Reports)

Sn.	Type of Lesions	Narrow Band Imaging (In Numbers)	Histopathology Correlation	Kappa Value
1	Benign Lesions	20	15	0.92
2	Premalignant Lesions	11	12	
3	Malignant Lesions	26	27	

The agreement between Narrow Band Imaging (NBI) and histopathological findings was evaluated to determine the diagnostic accuracy of NBI in detecting benign, premalignant, and malignant lesions.

Table 7: Comparison of Patients According To Findings in Colonoscopy Procedure (By White Light Endoscopy Compared With Histopathology Reports)

Sn.	Type of Lesions	White Light Endoscopy (In Numbers)	Histopathology Correlation (In Numbers)	Kappa Value
1	Benign Lesions	22	13	0.68
2	Pre-Malignant Lesions	1	9	
3	Malignant Lesions	18	18	

The agreement between colonoscopy with white band imaging and histopathological findings was analysed to evaluate the accuracy of colonoscopy in distinguishing between benign, premalignant, and malignant lesions.

Table 8: Comparison of Patients According To Findings in Colonoscopy Procedure (By Narrow Band Imaging Endoscopy Compared With Histopathology Reports)

Sn.	Type of Lesions	Narrow Band Imaging (In Numbers)	Histopathology (In Numbers)	Kappa Value
1	Benign Lesions	15	13	0.96
2	Pre-Malignant Lesions	8	9	
3	Malignant Lesions	18	18	

The agreement between Narrow Band Imaging (NBI) and histopathological findings was assessed to evaluate the diagnostic accuracy of NBI in detecting benign, premalignant, and malignant lesions.

Discussion

The detailed comparison of White Light Endoscopy (WLE) and Narrow-Band Imaging (NBI) across gastrointestinal procedures, including esophagogastroduodenoscopy (OGD) and colonoscopy, reveals significant insights into the diagnostic superiority of NBI.

Premalignant lesions often present with subtle mucosal and vascular alterations that are difficult to detect with traditional WLE. NBI's ability to highlight these vascular irregularities and microvascular changes makes it far more sensitive to these high-risk lesions.

Studies consistently show that WLE often misses premalignant conditions, with only a single lesion detected in cases where histopathology confirmed several. By contrast, NBI's imaging capabilities allow for the early identification and treatment of precancerous conditions, improving patient outcomes and reducing the risk of progression to malignancy.

The clinical implications of these findings are significant. NBI should be integrated into routine endoscopic evaluations, particularly for OGD and colonoscopy, where early detection of neoplastic changes is crucial for patient prognosis.

Conclusion

The comparison of White Light Endoscopy (WLE) and Narrow-Band Imaging (NBI) in various gastrointestinal procedures, including esophagogastroduodenoscopy (OGD) and colonoscopy, clearly demonstrates that NBI offers superior diagnostic accuracy, particularly in the detection of premalignant and malignant lesions.

Narrow-Band Imaging (NBI) should be integrated into standard endoscopic procedures as it significantly enhances diagnostic precision, especially in identifying premalignant and early-stage malignant lesions. Its superior ability to detect early neoplastic changes can prevent the progression of these conditions into advanced cancers, thereby improving patient outcomes.

Limitations

Narrow Band Imaging (NBI) offers significant advantages over White light endoscopy in detecting gastrointestinal lesions but has several limitations. It requires specialized training for accurate interpretation, which can vary based on the endoscopist's experience. NBI equipment is not always available, especially in resource-limited settings, and its high cost may limit widespread adoption. Additionally, while NBI is effective, discrepancies with histopathological results occasionally occur, highlighting the need for biopsy confirmation in certain cases. Further research is needed to assess NBI's effectiveness in other parts of the gastrointestinal tract, such as the small intestine. Addressing these challenges is key to maximizing NBI's clinical benefits.

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