

# **PENTAX Medical** i-scan Mini-Atlas for Gastroenterology

*Case studies from clinical practice with HD+ and i-scan.*



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## Visible excellence.

Gastrointestinal endoscopy with HD+ and i-scan.

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Dear readers,

Gastrointestinal endoscopy is facing exciting technical improvements. High-Definition (HD+) endoscopy combined with i-scan technology offers new visible details of the mucosal surface. This potentially leads to substantial improvements of endoscopic diagnosis. Detection as well as characterisation of mucosal abnormalities can be facilitated based on clear and detailed visualisation of the luminal surface. Vascular details and mucosal surface architecture is highlighted using HD+ and the i-scan modes.

This i-scan Mini-Atlas will give you a comprehensive overview about the imaging options of i-scan based on selected clinical cases of the upper and lower GI-tract. Dedicated and well known endoscopic centres have contributed to this unique case selection. Each case follows the same format, which represents the recommended algorithm using i-scan.

I would like to thank all authors and congratulate them for their excellent work and illustration of highly relevant clinical cases. I am convinced this booklet will help you to improve the quality of your daily work.

Ralf Kiesslich  
Professor of Medicine  
Johannes Gutenberg University of Mainz, Germany

# Your eyes are familiar with natural, sharp vision. Why give them anything less?

Enrich your endoscopic options with HD+ and i-scan.

The i-scan technology is based on the post processing of reflected light. i-scan can be switched on and off by simply pushing a button on the endoscope. The different i-scan modes Surface Enhancement and Tone Enhancement will be subsequently displayed on the monitor. i-scan Surface Enhancement (SE) highlights surface tissue architecture which may be used for the detection of circumscribed lesions or to highlight diffuse alteration (e.g. inflammation, atrophy). i-scan Tone Enhancement (TE) focuses on vascular and tissue architecture. These details are helpful to correctly characterise mucosal lesions. Neoplastic vessel and tissue patterns may be differentiated from non-neoplastic patterns.

Detection and characterisation are important steps during routine endoscopy. First, all suspicious areas have to be identified. Subsequently, the endoscopist has to decide if an endoscopic intervention (e.g. biopsy, endoscopic resection) is needed. The i-scan technology supports both steps and is of great help for everyday endoscopic practice.

Prof. Ralf Kiesslich

## Equipment and approach for the i-scan case collection

In combination with the EPK-i series processors, the HD+ images taken with the HD+ series endoscopes currently provide the highest endoscopic image resolution available. This equipment was used exclusively for capturing this case studies in the i-scan Mini-Atlas. For further information on the products, please refer to the PENTAX Medical product overview.

The i-scan cases were collected in hospitals all over Europe in 2011. All cases were documented in the same structure: patient history, endoscopic findings and patient outcome. All clinical images were acquired in identical sequence: HD+ white light endoscopy, i-scan Surface Enhancement and i-scan Tone Enhancement. This makes the cases comparable and provides a good impression of the clinical value of i-scan.

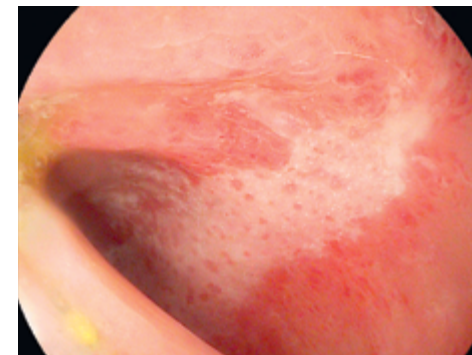
Our special thanks goes to the editorial board of this i-scan Mini-Atlas, Prof Ralf Kiesslich of Mainz University Hospital and Dr. Silvia Sanduleanu of Maastricht University Medical Center.

Advantages of HD+ and i-scan at a glance.



Images of extraordinarily High-Definition (HD+) and excellent illumination

- Supports fast orientation and detection
- Significant improvement in the visibility and evaluation of minute lesions
- Integrated zoom function for more detailed inspection of suspicious surface structures



Detection and delineation support with i-scan Surface Enhancement (SE)

- i-scan SE retains the natural color tones
- Accentuation of tissue structures at the touch of a button
- Mucosal enhancement potentially supports the detection of flat lesions



Support in characterisation with i-scan Tone Enhancement (TE)

- Specific imaging technology for further assistance in endoscopic procedures
- Allows more accentuated display of mucosal structures which may support lesion characterisation
- Virtual chromoendoscopy may help to improve endoscopic diagnosis

# i-scan in characterisation of Barrett's oesophagus.

## Patient history

A 67 year old man with reflux symptoms was referred for an upper gastrointestinal endoscopy after no relief with proton pump inhibitors. At endoscopy, he was found to have a Barrett's oesophagus C3M5, according to the Prague classification.

## Endoscopic findings

With HD+ white light endoscopy, we identified an area of mucosa that appeared slightly featureless on initial examination.

With the addition of i-scan SE, this area became more evident. Normal glandular mucosa surrounded a central area where the mucosal pattern was irregular and distorted.

Using i-scan TE, this area was more evident and one can see subtle vascular abnormalities at the bottom of the image with some blind ending vessels suggestive of dysplasia.

## Patient outcome and follow-up

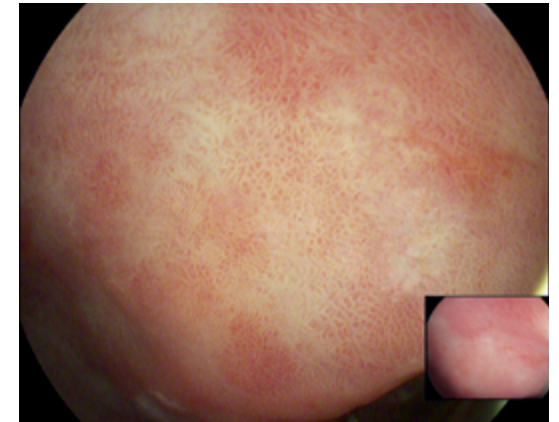
This area was biopsied and demonstrated high-grade dysplasia. The patient underwent HALO radio frequency ablation. An initial circumferential balloon ablation followed 8 weeks later by focal ablation using a HALO 90 catheter to some residual areas. At 12 months follow-up, complete reversal of dysplasia (CR-D) and intestinal metaplasia (CR-BE) with evidence of squamous reepithelialisation of his previous Barrett's segment was found.

## Summary

In this case, the use of HD+ and i-scan allowed in vivo characterisation of the Barrett's oesophagus and targeted biopsies. Accurate diagnosis contributed to targeted therapy.

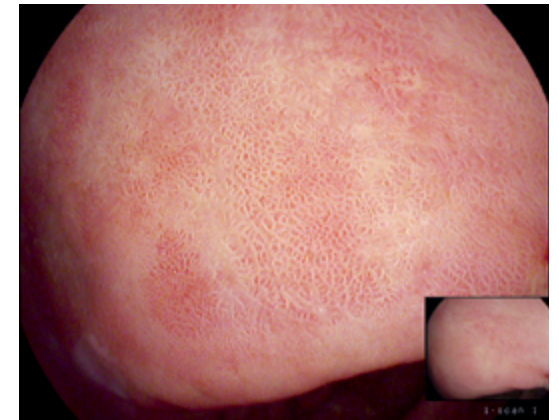
## Image 1:

Segment of Barrett's mucosa with slightly featureless area, HD+



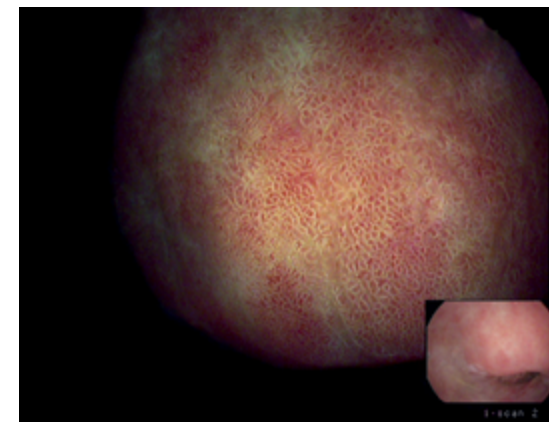
## Image 2:

Mucosal pattern in central area irregular and distorted, i-scan SE



## Image 3:

Subtle vascular abnormalities including some blind ending vessels demonstrate HGD, i-scan TE



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# i-scan in surveillance endoscopy in a patient with familial adenomatous polyposis.

## Patient history

A 42 year old woman with familial adenomatous polyposis (FAP) syndrome presented for esophagogastroduodenoscopy. She underwent her first colonoscopy five years ago, because both her father and uncle died of colorectal cancer at the ages of 45 and 50, respectively. Her first colonoscopy revealed more than 100 small polyps throughout the colon which were all tubular adenomas. DNA analysis showed a mutation of the APC gene confirming the diagnosis of FAP. A protective total colectomy was subsequently performed to prevent development of colon cancer.

## Endoscopic findings

With HD+ white light imaging, some small flat lesions with a whitish coloration could be detected (image 1).

i-scan SE allowed better delineation of the lesions and highlighted mucosal architecture. Image 2 clearly shows a flat lesion with an irregular surface and a possible central depression. i-scan TE further helped to characterise and confirm the identified lesion as an advanced adenoma based on the irregular pattern architecture and was helpful to fully clarify the central depression with the infiltrative appearance (image 3).

## Patient outcome and follow-up

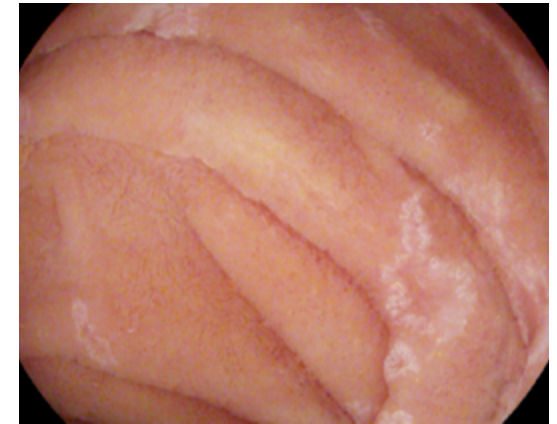
The lesion was endoscopically resected and the final histological analysis confirmed an adenoma with a high-grade dysplasia.

## Summary

With regard to targeted diagnosis and therapy of duodenal adenomas in patients with FAP syndrome, this case stresses the importance of endoscopic information gained by HD+ resolution in combination with i-scan SE and TE.

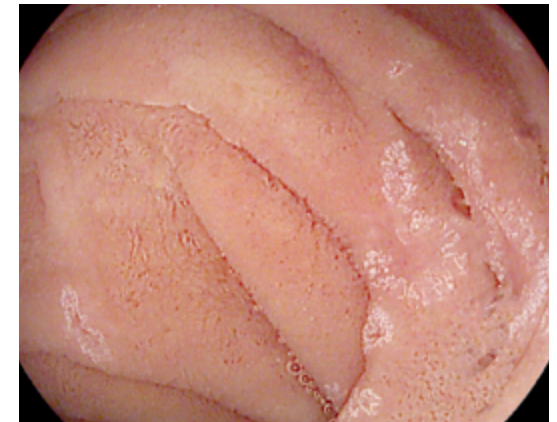
## Image 1:

Image showing flat lesions with a whitish coloration, HD+



## Image 2:

Highlighted mucosal architecture with targeted recognition of flat lesion, i-scan SE



## Image 3:

Characterisation of the pattern architecture using i-scan TE



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# i-scan in diagnosis of gastric adenoma.

## Patient history

A 55 year old female patient was referred to our GI unit for endoscopic submucosal dissection of a lesion at the gastric angular fold. Biopsies taken at the referring hospital revealed an adenoma with high-grade intraepithelial neoplasia (HGIN).

## Endoscopic findings

The upper gastrointestinal endoscopy showed a flat-depressed lesion (IIa–c according to the Paris classification) at the angular fold measuring approximately 42 mm x 37 mm in diameter.

HD+ white light imaging clearly shows the lesion.

By adding i-scan SE, the margins of the lesion can be spotted more clearly and the depressed areas become visible more easily.

By adding i-scan TE, no areas with a loss of pit pattern or ulceration could be identified. Based on these findings, the decision for performing endoscopic submucosal dissection was taken.

## Patient outcome and follow-up

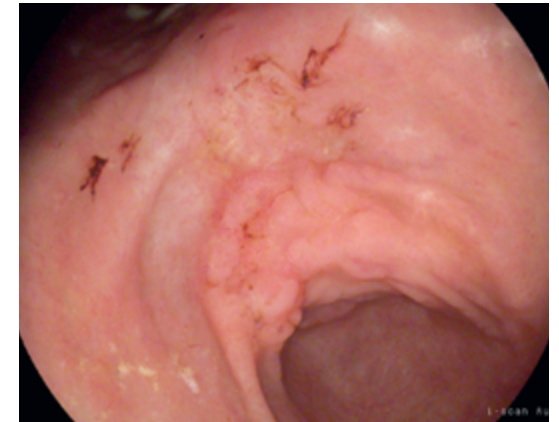
The lesion was resected en-bloc. During the procedure, no major bleeding occurred and no perforation could be spotted. However, after the intervention, the patient complained of abdominal pain and free air was diagnosed by CT scan. The patient received i.v. antibiotics and was put on nil per mouth. Four days later, she was symptom-free and oral intake could be restarted. The final result was gastric adenoma with high-grade intraepithelial neoplasia (diameter 42 mm x 37 mm, R0).

## Summary

This case shows that HD+ and i-scan led to the appropriate treatment of the patient and to the resection of the lesion en-bloc.

## Image 1:

Gastric adenoma at the angular fold, HD+



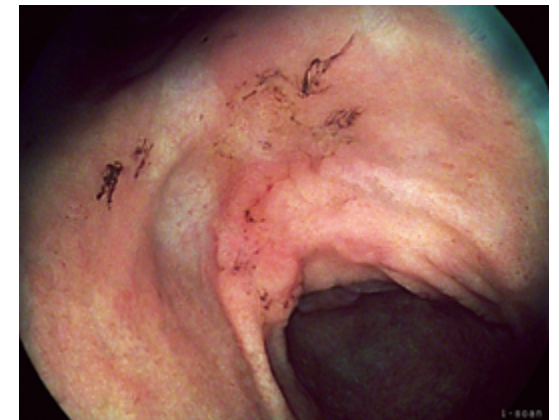
## Image 2:

Gastric adenoma at the angular fold, i-scan SE



## Image 3:

Gastric adenoma at the angular fold, i-scan TE



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# Gastric high-grade dysplasia of the antrum demonstrated with i-scan.

## Patient history

This 62 year old male patient was brought in with a long history of intermittent upper abdominal pain and a known gastric ulcer of at least 30 years. He was found to have an incidental positive faecal occult blood test and underwent colonoscopy and upper gastrointestinal endoscopy. There was no history of melaena or vomiting. Apart from hypertension, for which he was taking anti-hypertensives, he was well.

## Endoscopic findings

The oesophagus and duodenum were normal. The stomach distended easily and views were obtained.

Initial HD+ white light endoscopy demonstrated a flat lesion (IIa) with central depression, measuring 20 mm x 20 mm in the gastric antrum just proximal to the pylorus. The surface architecture appeared villous on initial views with a ridged pattern. With i-scan SE, the villous pattern and ridges became clearer, suggesting dysplasia.

With the addition of i-scan TE, the vascular pattern was demonstrated and shown to be both enhanced and irregular. These findings raised the possibility of dysplasia. Biopsies confirmed a gastric adenoma with high-grade dysplasia.

## Patient outcome and follow-up

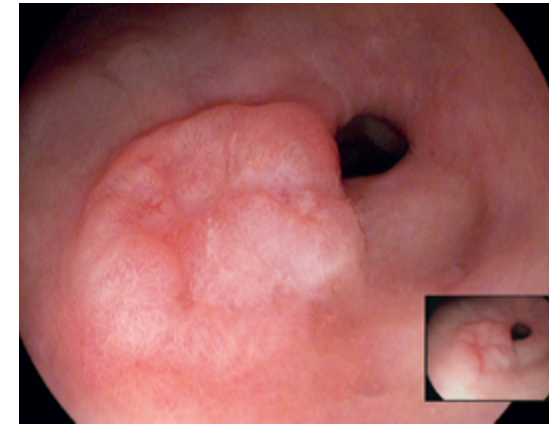
The polyp was successfully removed via endoscopic submucosal dissection. At 6 months follow-up, there was no evidence of any residual or recurrent dysplasia.

## Summary

In this case, HD+ and i-scan helped to take targeted biopsies.

## Image 1:

20mm flat lesion in the gastric antrum, villous with ridged pattern, HD+



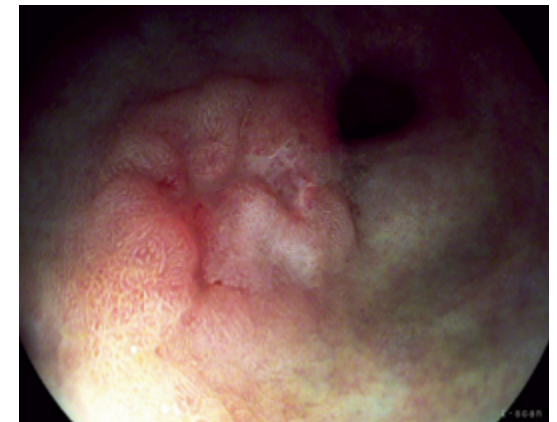
## Image 2:

Villous pattern more apparent, deep ridges suggesting dysplasia, i-scan SE



## Image 3:

Enhanced and irregular vascular pattern confirmed as gastric adenoma with HGD, i-scan TE



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# Analysis of a gastric polyp using i-scan.

## Patient history

A 56 year old patient was admitted to her local emergency room with malaena and was found to be significantly anaemic. After aggressive resuscitation, she underwent endoscopy and was found to have a pre-pyloric ulcer which was bleeding. She underwent endotherapy with adrenaline and endo-clips and was discharged. Biopsies from the ulcer edge taken at the initial examination showed high-grade dysplasia. She returned 4 weeks later for a repeat endoscopy.

## Endoscopic findings

At the repeat HD+ white light endoscopy, an obvious polyp was found in the antrum in the pre-pyloric area. There was a central core from the previous ulcer with scar tissue and a lack of mucosal definition.

With i-scan SE, it became apparent that the mucosa around this area was irregular and disordered. The normal circular mucosal pattern was replaced by longer and more irregular mucosa. Intestinal metaplasia was seen at the edges of the lesion.

With i-scan TE, this irregularity was more pronounced with the addition of coiled, dilated and blind-ending vasculature in keeping with dysplasia.

## Patient outcome and follow-up

Histology confirmed high-grade dysplasia. Endoscopic ultrasound showed no distant disease. The patient underwent an endoscopic submucosal resection with clear resection margins. At 6 months follow-up, there was no evidence of recurrent dysplasia at the site of resection. Due to the presence of chronic atrophic gastritis within the remainder of the stomach, we advised intensive surveillance.

## Summary

HD+ and i-scan supported the characterisation of the epithelial surface and vascularisation of gastric mucosal lesions and can assist treatment and surveillance decisions.

## Image 1:

Pre-pyloric ulcer, biopsies suggest HGD, HD+



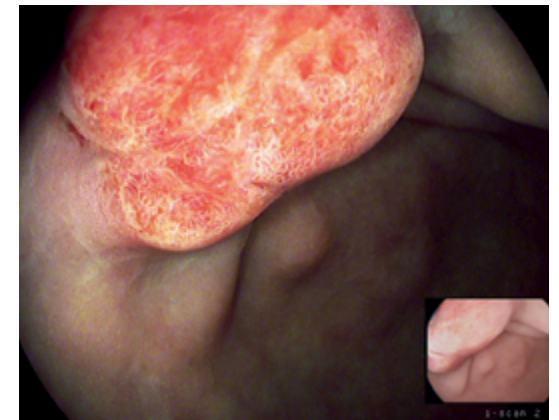
## Image 2:

Mucosal patterns irregular and disordered, i-scan SE



## Image 3:

Irregularity more pronounced, coiled, dilated and blind ending vasculature in keeping with dysplasia, i-scan TE



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# Detection and characterisation of colorectal polyps using i-scan.

## Patient history

A 61 year old male patient at the outpatient clinic had chronic diarrhoea with four loose stools a day. His medical history showed type 2 diabetes and COPD. A colonoscopy was performed to rule out colon pathology as a cause for his symptoms.

## Endoscopic findings

HD+ white light colonoscopy (image 1) revealed a sessile lesion (Paris 0–Is) located in the transverse colon and measuring approx. 30mm x 20mm.

Optical examination using i-scan SE and TE (images 2 and 3) allowed better demarcation of the borders and characterisation of the epithelial pit pattern which showed large tubular pits (IIIL, Kudo classification), indicating an adenomatous lesion.

## Patient outcome and follow-up

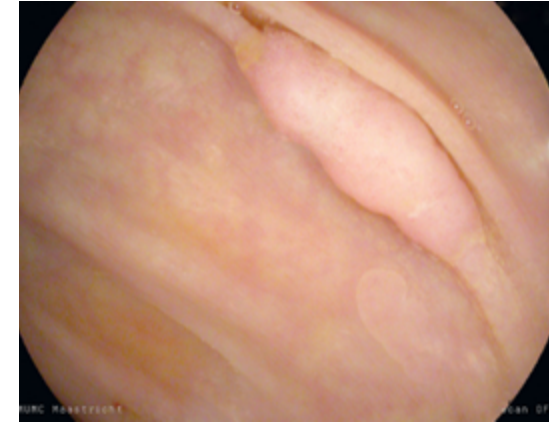
After lifting with saline, we removed this lesion using EMR. Histology showed a tubular adenoma with low-grade dysplasia which was radically resected. As stated in current surveillance guidelines, a follow-up colonoscopy was recommended in 3 years.

## Summary

This case illustrates the need for careful examination and characterisation of colorectal polyps using HD+ and i-scan, to fine-tune the diagnosis and improve the quality of colonoscopic cancer prevention.

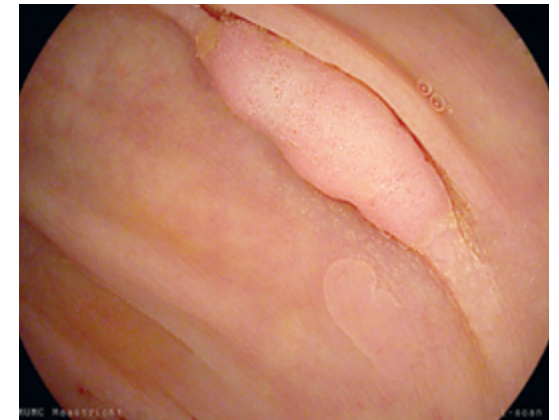
## Image 1:

Flat lesion in transverse colon, HD+



## Image 2:

Flat lesion in transverse colon, i-scan SE



## Image 3:

Flat lesion in transverse colon, i-scan TE



Rogier de Ridder, MD

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Maastricht University  
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# Detection and characterisation of dysplasia in ulcerative colitis using i-scan.

## Patient history

A 79 year old man with long-standing ulcerative colitis, currently in remission, was referred to our endoscopy unit for surveillance colonoscopy.

## Endoscopic findings

The rectum and left colon showed a relatively normal pit pattern and some pseudopolyps, indicating chronic inflammation.

Using HD+ white light image, a 60mm large circumscribed lesion with irregular margins (0–IIa LST of non-granular type) was found in the right colon.

i-scan SE and TE helped to demarcate the borders of the lesion (image 2 and 3) and supported the characterisation of the epithelial surface (Kudo pit pattern type II and IIIL).

## Patient outcome and follow-up

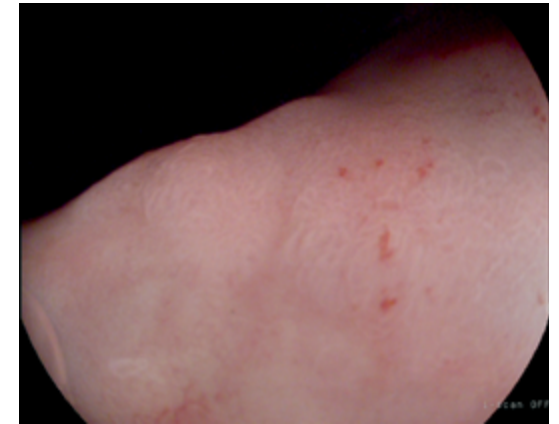
The histology revealed low-grade dysplasia. A colectomy was recommended to the patient, but he declined. The area was treated with piece-meal mucosa resection (EMR) using the 'inject and cut' technique. During the 6-month follow-up colonoscopy, a scar was found with Kudo pit pattern type I. The absence of adenomatous tissue was confirmed by histology.

## Summary

In this case, HD+ and i-scan helped the endoscopist to better visualise and characterise the lesion, thereby allowing appropriate treatment.

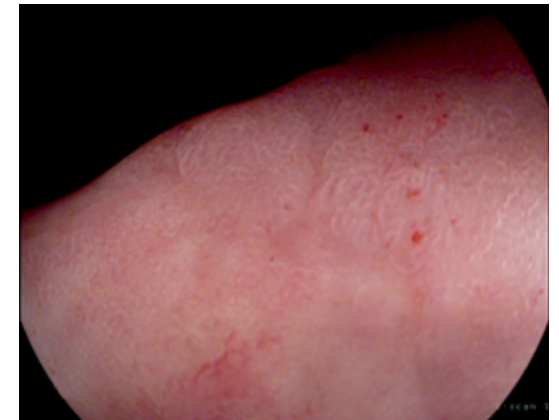
## Image 1:

Ulcerative colitis, HD+



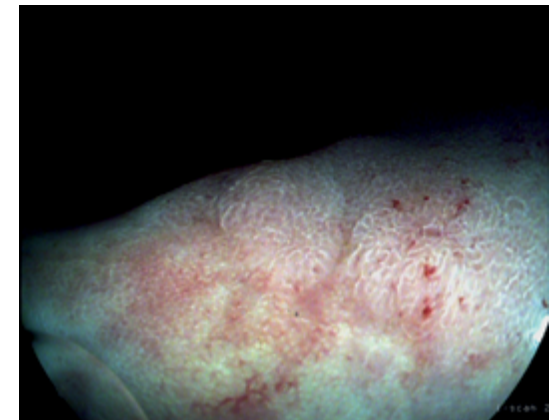
## Image 2:

UC findings, i-scan SE



## Image 3:

UC evidence, i-scan TE



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# Analysis of colorectal cancer using i-scan.

## Patient history

A 72 year old man was referred to our emergency department because of dizziness and discomfort. On physical examination, the skin appeared pale. Laboratory investigation showed anaemia with haemoglobin of 7.8 g/dl (reference 13–17), serum iron of 35 µg/dl (40–160) and C-reactive protein of 90 mg/l (< 5). Faecal occult blood testing was positive. EGD was normal.

## Endoscopic findings

HD+ white light colonoscopy (image 1) revealed a large neoplasia in the ascending colon with a central depression. Analysis of the remaining colon revealed no further lesions.

i-scan SE (image 2) strongly highlighted the borders of the lesion.

Corresponding with the central depression, virtual chromoendoscopy with i-scan TE (image 3) clearly demonstrated an irregular arrangement of the lesion and a mix of Kudo pit patterns, namely types IIIS, IIIL and IV and V.

## Patient outcome and follow-up

Diluted epinephrine was injected but the polyp showed no sign of lifting. Using India ink, endoscopic tattooing of the lesion was performed, then the patient was referred for surgery. Right hemicolectomy was performed and histopathological analysis of the resected specimen showed a well-differentiated colorectal adenocarcinoma finally staged as T2N0M0.

## Summary

This case illustrates the clinical use of HD+ and i-scan in the proper evaluation of dysplastic lesions in ulcerative colitis.

## Image 1:

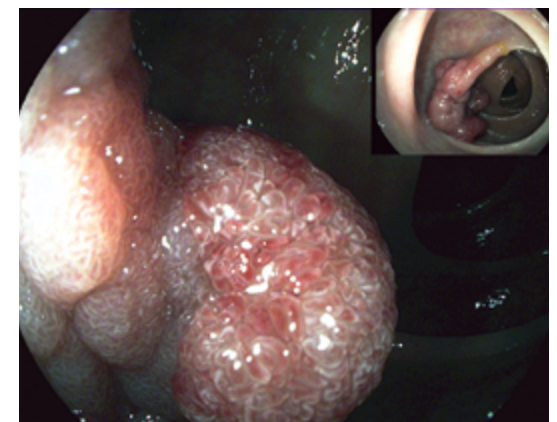
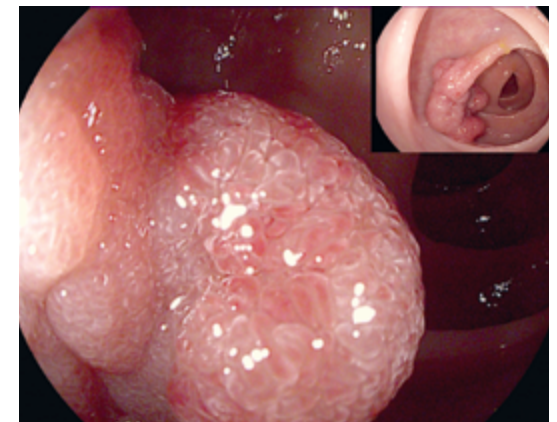
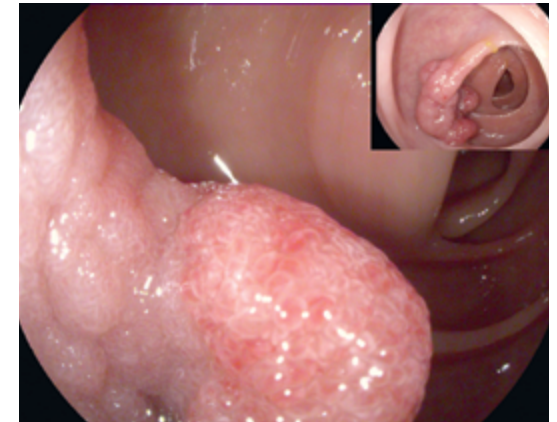
Colorectal cancer, HD+

## Image 2:

Colorectal cancer, i-scan SE

## Image 3:

Colorectal cancer, i-scan TE



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# Detection and characterisation of non-polypoid colorectal neoplasms (NP-CRN) using i-scan.

## Patient history

A 61 year old male patient was admitted to the outpatient clinic because of chronic diarrhoea with four loose stools a day. His medical history showed type 2 diabetes and COPD. A colonoscopy was performed to rule out colon pathology as a cause for his symptoms.

## Endoscopic findings

HD+ white light colonoscopy (image 1) revealed a slightly elevated (height < ½ diameter) non-polypoid lesion suggesting a central depression (Paris 0–IIa + c). The lesion was located in the ascending colon, measuring approx. 25 mm x 20 mm.

Using i-scan SE and TE (image 2 and 3) optical examination helped clarify the borders of the lesion and allowed characterisation of the large and small tubular pits (Kudo pit patterns, type IIIL + IIIs), suggesting an adenomatous lesion.

## Patient outcome and follow-up

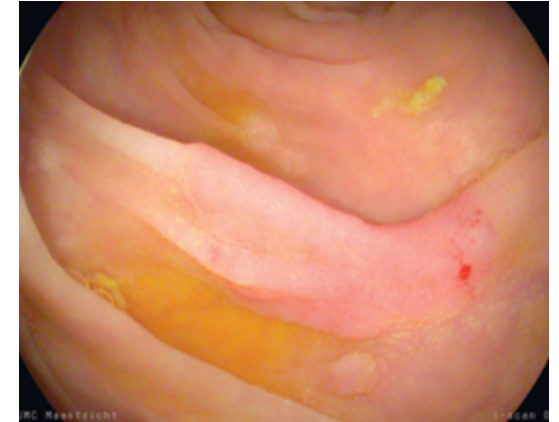
After lifting with saline, we removed this lesion using EMR. Histopathology showed a tubular adenoma with low-grade dysplasia. As stated in current surveillance guidelines, a follow-up colonoscopy was recommended in 3 years.

## Summary

This case highlights the need for careful examination and accurate characterisation of NP-lesions. These lesions can be easily overlooked, especially with poor bowel preparation or insufficient experience and training of the endoscopist, some of the lesions being at the origin of post-colonoscopy (i.e. interval) cancer. In this case, the use of HD+ and i-scan SE and TE helped the endoscopist detect and characterise this lesion.

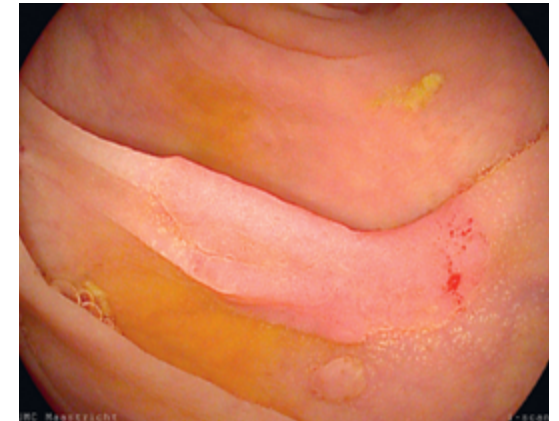
## Image 1:

Flat lesion in ascending colon, HD+



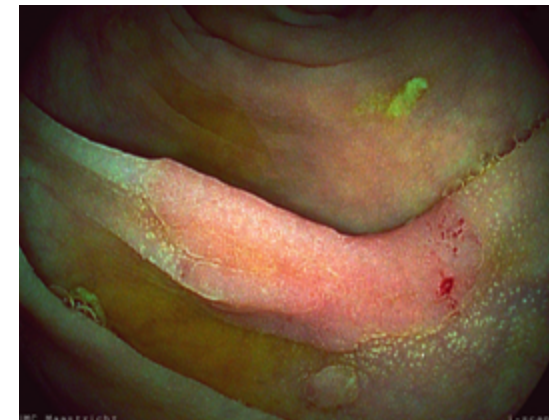
## Image 2:

Flat lesion in ascending colon, i-scan SE



## Image 3:

Flat lesion in ascending colon, i-scan TE



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# Detection of pit pattern in a colonic LST lesion using i-scan.

## Patient history

A 65 year old male was referred to our endoscopy unit for screening colonoscopy.

## Endoscopic findings

Using HD+ white light image, a 40mm large superficial lesion, classified as 0-Is + IIa type LST located astride a fold (image 1A) was found in the ascending colon. The visible Kudo pit pattern type IIIL and IV suggested endoscopic mucosa resection (EMR) as a possible therapeutic option. However, submucosal injection exposed a circumscribed area of the lesion (image 1B) with ambiguous pit pattern (image 1C).

Closer examination using i-scan SE and TE (image 2 and 3) revealed a destructured and irregular Kudo pit pattern type VI, meaning a high risk of invasive cancer (>30 %).

## Patient outcome and follow-up

To assess the histological malignancy (R0), en-bloc resection was the best possible treatment, so a submucosal dissection (ESD) was performed.

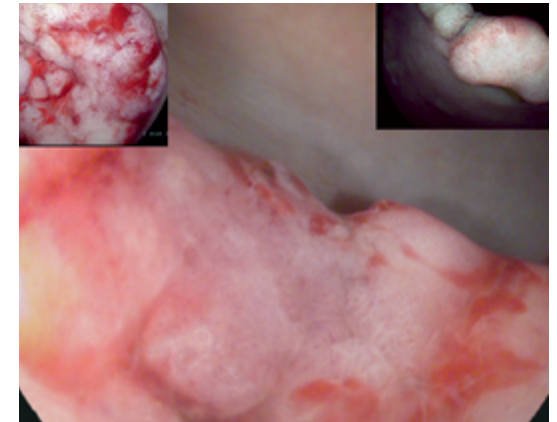
The histology revealed tubulovillous adenoma with high-grade dysplasia and intramucosal carcinoma corresponding with Kudo pit pattern type VI. There was no submucosal infiltration. The resection was considered radical. The patient was discharged 72 hours after the procedure. At the 6 month follow-up colonoscopy, the scar showed Kudo pit pattern type I. The absence of adenomatous tissue was histologically confirmed.

## Summary

The examination with HD+ and i-scan allowed the endoscopist to more precisely choose the best therapeutic option for this complex lesion.

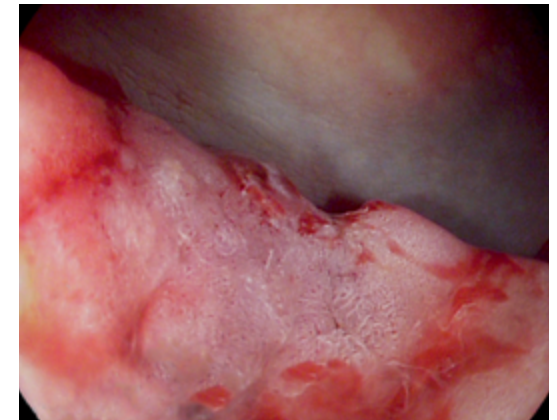
## Image 1:

- A) LST 0-Is + IIa
- B) After injection, retrospective view
- C) Close view, HD+



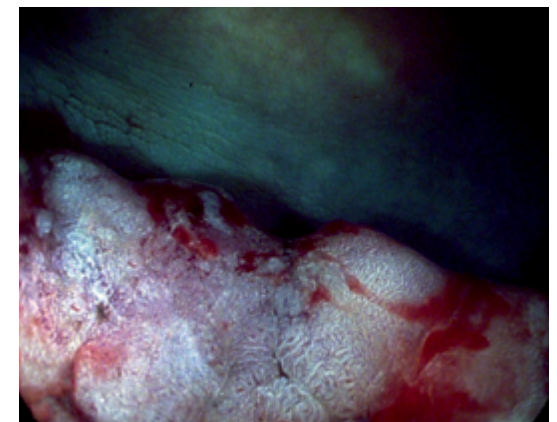
## Image 2:

Colonic LST lesion, i-scan SE



## Image 3:

Colonic LST lesion, i-scan TE



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# Pedunculated polyp pit pattern analysis for advanced endoscopic imaging using i-scan.

## Patient history

A 60 year old female patient was referred to our hospital for surveillance colonoscopy. Physical examination and laboratory values were inconclusive. The patient had no positive family history for colorectal cancer.

## Endoscopic findings

HD+ white light colonoscopy (image 1) revealed a 15 mm pedunculated polyp in the sigmoid colon.

i-scan SE and TE (image 2 and 3) strongly highlighted the borders of the lesion to the stalk and allowed distinct pit pattern analysis which showed large tubular and roundish Kudo pit patterns type IIIL, thereby suggesting an adenomatous lesion.

## Patient outcome and follow-up

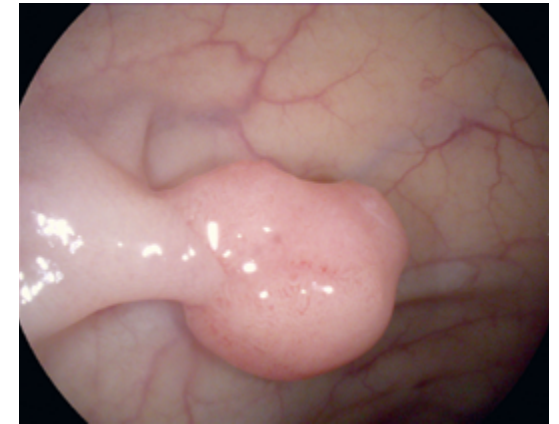
After injection of diluted epinephrine into the stalk, the polyp was completely removed via snare polypectomy. Histopathological analysis confirmed endoscopic diagnosis by showing a tubular adenoma without high-grade intraepithelial neoplasia. As stated in current surveillance guidelines, a follow-up colonoscopy was recommended in 3 years.

## Summary

This case illustrates the clinical advantages of HD+ and i-scan for characterisation of colorectal polyps.

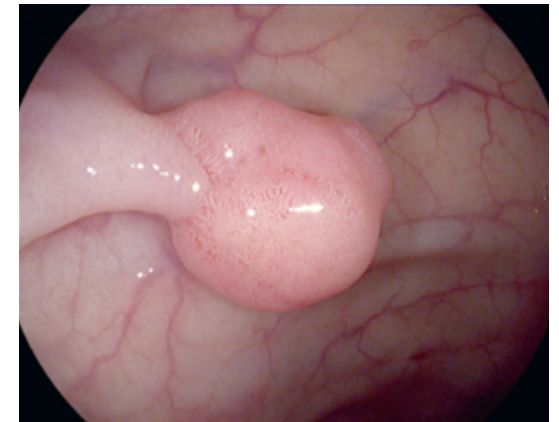
## Image 1:

Pedunculated polyp, HD+



## Image 2:

Pedunculated polyp, i-scan SE



## Image 3:

Pedunculated polyp, i-scan TE



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# Colonoscopy for examination of the mucosal scar after polypectomy using i-scan.

## Patient history

A 66 year old male patient with local excision of sessile rectal polyp near the anocutaneous line was brought in for a surveillance colonoscopy in a gastroenterological practice. The histological evaluation confirmed an early cancer in the rectum. To achieve a complete resection, a second endoscopy was performed without any indices of the residual lesions under standard resolution without virtual or intravital staining. The patient was referred to our endoscopy unit for further diagnostic and therapeutic treatment.

## Endoscopic findings

HD+ white light imaging did not show any suspicious lesions except the polypectomy scar (image 1).

i-scan SE was activated for clearer detection of any adenomatous lesions within the normal appearing mucosa. Image 2 shows a sessile lesion with a villous and cerebriform pits surface structure with a sharp demarcation from the scar and normal mucosa.

Next, i-scan TE was activated in addition to characterise the identified lesions as the remaining part of the previous case of cancer based on the irregular pattern architecture (image 3).

## Patient outcome and follow-up

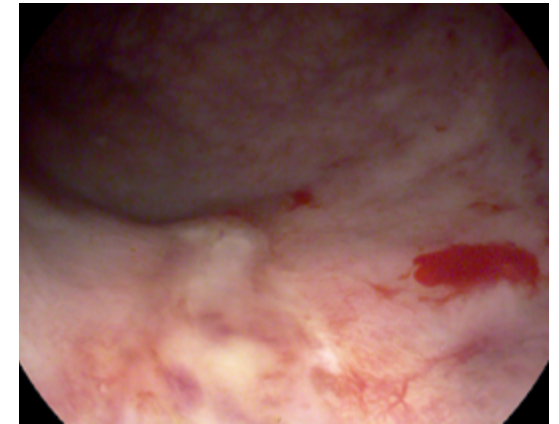
Because of the scarred tissue and because the injection with saline had no lifting effect, endoscopic resection failed and the patient underwent a transnasal endoscopic microsurgery (TEM) procedure.

## Summary

Using HD+ and i-scan for careful examination of the scar after polypectomy revealed residual adenomatous tissue and allowed better treatment.

## Image 1:

Imaging without detection of any suspicious lesions, HD+



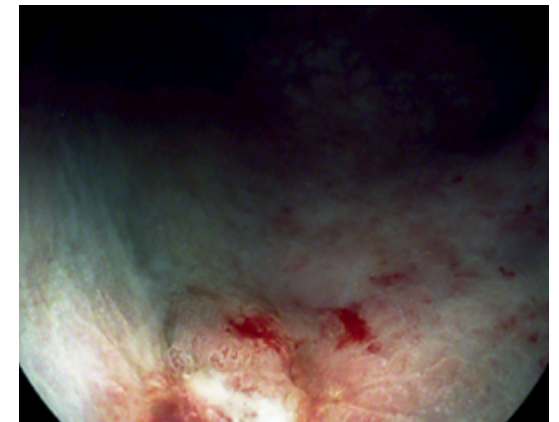
## Image 2:

Detection of minute and flat polypoid lesions at the border of the scar in frontal view, i-scan SE



## Image 3:

Characterisation of the surface with an irregular pattern architecture, i-scan TE



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# Colonoscopy for pit pattern analysis of colorectal polyps using i-scan.

## Patient history

A 56 year old man was referred to our hospital for surveillance colonoscopy. Physical examination as well as laboratory investigations were inconclusive.

## Endoscopic findings

HD+ white light endoscopy (image 1) revealed a 6 mm sessile polyp in the rectum with indistinct borders. Analysis of the rest of the colon revealed no further lesions.

i-scan SE (image 2) clearly demonstrated the borders of the polyp and interruption of normal vascular structures.

Virtual chromoendoscopy with i-scan TE (image 3) clearly highlighted Kudo pit pattern type IIIL on the lesion, thereby suggesting an adenoma.

## Patient outcome and follow-up

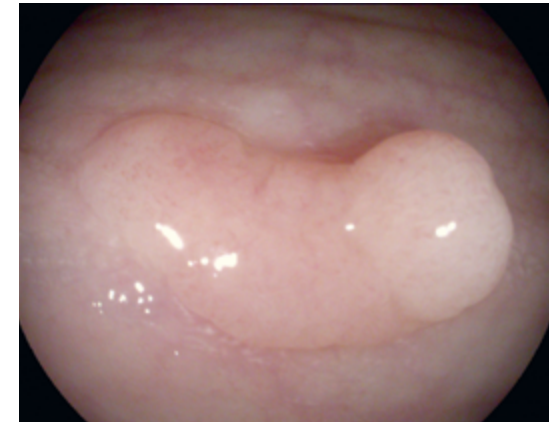
The polyp was resected in toto by snare polypectomy without complications. Histopathological analysis revealed a tubular adenoma without high-grade intraepithelial neoplasia. As stated in current surveillance guidelines, a follow-up colonoscopy was recommended in 3 years.

## Summary

In this case, HD+ and i-scan helped the endoscopist to perform an in vivo characterisation of colorectal polyps.

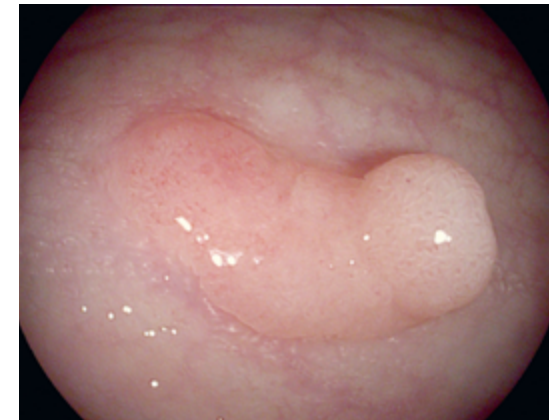
## Image 1:

Sessile polyp, HD+



## Image 2:

Sessile polyp, i-scan SE



## Image 3:

Sessile polyp, i-scan TE



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