VALIDATION OF TEIXEIRA OPTIC MAGNIFYING FICE VASCULAR PATTERN OF COLORECTAL LESIONS WITH OPTIC MAGNIFYING NBI: A PILOT STUDY

Validación de la magnificación óptica FICE de Teixeira para el patrón vascular de las lesiones colorrectales con un magnificador óptico NBI: un estudio piloto

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Abstract

Objective: A recent classification of the vascular pattern (VP) of colorectal polyps was introduced by Teixeira et al, using magnifying FICE. This pilot study aims to achieve Teixeira's FICE VP classification (TVP) of colorectal lesions through NBI magnification. Methods: From 2010 to 2011, 32 patients and 54 colorectal lesions were evaluated at Centro Médico Docente La Trinidad (CMDLT), Department of Gastroenterology, Caracas-Venezuela. Olympus magnifying colonoscopies and NBI were performed by three independent endoscopists, using the TVP classification. A fourth endoscopist of Porto Alegre-Brazil from the Department of Gastroenterology of FUGAST received the electronic files of the 54 cases in a digital image filing system. Random numbers of 54 pictures were allocated to readers 1 to 4. Diagnostic accuracy of the TVP was determined against the histopathological diagnosis, as neoplasia or no neoplasia; adenoma with low/high grade dysplasia vs. deeply invasive adenocarcinoma. Kappa in reference to TVP was recorded. Specificity, sensibility, positive (PPV) and negative (PPN) predictive values to assess the neoplastic or non neoplastic nature of the lesion were determined. Results: Kappa values of 0.84259259 (0.63-0.84); Specificity (0.943 ± 0.013); sensibility (0.825 ± 0.126); PPV (0.960 ± 0.029) and PPN (0.765 ± 0.062) were obtained for TVP. Conclusions: This pilot study shows that a formerly TVP, can be reproduced with Olympus magnifying NBI. Since no VP classification has yet proven to be paramount in predicting the histology in colorectal lesions, a larger scale trial using both systems would be the best way to attain a more universal classification.

Key Words: *Colorectal tumors, colorectal adenomas, colorectal adenocarcinoma, magnifying NBI, magnifying FICE, vascular pattern.*

Resumen

Objetivo: Una clasificación reciente del patrón vascular (PV) de los pólipos colorrectales fue introducida por Teixeira et al, utilizando la magnificación FICE. Este estudio piloto tiene como objetivo lograr la clasificación del PV FICE de Teixeira (PVT) de las lesiones colorrectales través ampliación NBI. Métodos: A partir de 2010 a 2011, 32 pacientes y 54 lesiones colorrectales fueron evaluados en el Centro Médico Docente La Trinidad (CMDLT), Departamento de Gastroenterología, Caracas-Venezuela. Las Colonoscopias de aumento de Olympus y NBI fueron realizadas por tres endoscopistas independientes, utilizando la clasificación PVT. Un cuarto endoscopista de Porto Alegre-Brasil del Departamento de Gastroenterología del FUGAST recibió los archivos electrónicos de los 54 casos en un sistema de imagen de presentación digital. Los números aleatorios de las 54 fotos fueron asignados a los lectores 1 a 4. La precisión diagnóstica del PVT se determinó en contra del diagnóstico histopatológico, como neoplasia o ninguna neoplasia; adenoma con displasia de grado bajo/alto vs. adenocarcinoma profundamente invasivo. Se registró el Kappa en referencia al PVT. La especificidad, sensibilidad, los valores predictivos positivos (VPP) y negativos (VPN) para evaluar la naturaleza neoplásica o no de la lesión fueron determinados. Resultados: los valores de Kappa de

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0.84259259 (0.63-0.84); Especificidad (0,943 ± 0,013); sensibilidad (0,825 ± 0,126); VPP (0,960 ± 0,029) y VPN (0.765 ± 0.062) fueron obtenidos para el PVT Conclusiones: Este estudio piloto muestra que un antiguamente PVT, puede ser reproducido con Olympus de aumento NBI. Puesto que ninguna clasificación del PV ha demostrado ser de suma importancia en la predicción de la histología de las lesiones colorrectales, un ensayo a mayor escala utilizando ambos sistemas sería la mejor manera de lograr una clasificación más universal.

Palabras clave: tumores colorrectales, adenomas colorrectales, adenocarcinoma colorrectal, magnificación NBI, magnificación FICE, patrón vascular.

INTRODUCTION

Olympus Narrow Band Imaging (NBI) has proven to be of great value in enhancing the capillary vessels of colorectal polyps, without optical magnification, to determine the absence/presence of vascular network, in the understanding that a rich vascular network could mean neoplasia.[1]

The tumoral capillary phenotype has as a characteristic: the loss of its architecture and as more aberrant it becomes, the more aggressive the neoplasia is. Therefore, any method capable of showing this feature is of great value to predict histopathology. When applying optical zoom, the morphology of the vascular pattern can be seen.[2] Thus, it is possible to predict with accuracy normal superficial colon capillaries, inflammatory/hyperplastic lesions, adenoma with low-/high-grade dysplasia and deeply invasive adenocarcinoma into the deeper submucosal layer or beyond.[3] These findings provided the possibility of developing several classifications where the morphology of capillaries in colorectal lesions could be arranged into certain patterns with variable degrees of relationship to constant pathologic features.[4-6] This great advance impacts directly in forecasting both diagnosis and staging of colorectal tumors during endoscopy at the time of the decision-making about the best therapeutic choice: endoscopic procedure (cold/hot forceps, snare polypectomy, endoscopic mucosal resection or endoscopic sub mucosal dissection) vs. surgical approach. The focus on tumor-like inflammatory conditions also has room in the spectrum of possibilities of these techniques.

So far most of these proposed classifications are developed by Olympus optic magnifying and NBI.[4-6,13]

The first approaches using Fuji Intelligent Color Enhancement System (FICE) and optic magnifying zoom was proposed recently by Teixeira et al,[7] with excellent results in terms of description of vascular pattern morphology related to constant pathological features of colorectal lesions leading to a new classification of the vascular pattern (TVP), Fig. 1. It is still uncertain whether both technologies could have equivalent results.

This pilot study was undertaken for the purpose of obtaining the TVP of colorectal lesions using Olympus optic magnifying NBI.

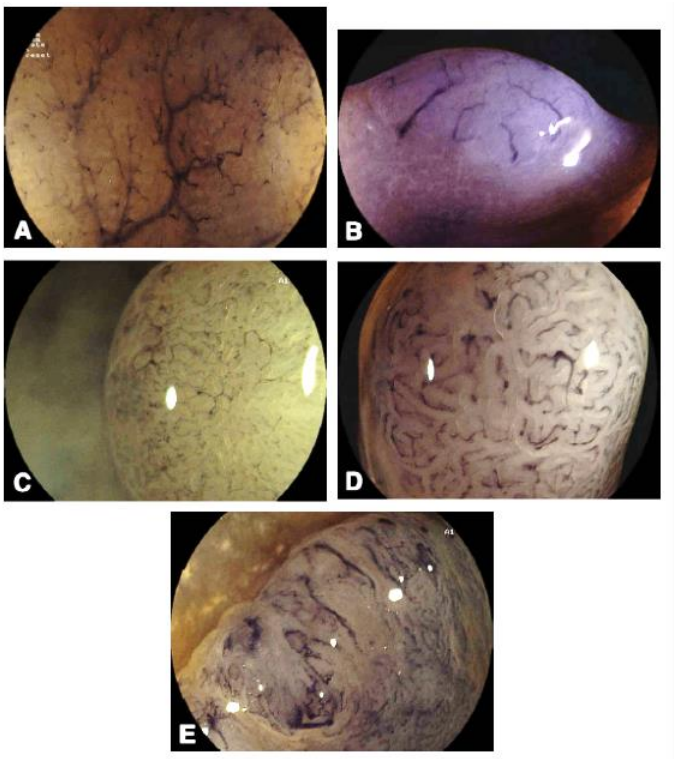

Figure 1. Endoscopic capillary-vessel pattern classification.

The I to V vascular pattern was defined according with the normal vascular pattern as defined in Type I. **A)** Type I: normal pattern surrounding the mucosal crypts. Vessels run with a constant diameter, becoming thinner in the most superficial area, beneath the epithelium, with branched ends. **B)** Type II: hypovascularity, capillaries of a thicker diameter, curved or straight but uniform. **C)** Type III: capillaries of thinner diameter, irregular and tortuous, point dilatations, spiral shape, periglandular arrangement. **D)** Type IV: numerous, spiral, or straight capillaries, thicker diameter, dilatations by segments. **E)** Type V: bizarre shape of vessels, without organized distribution, numerous thick vessels in combination with non vascular areas.

METHODS

Medical records and image files of 31 patients and 54 colorectal lesions were retrospectively evaluated during a 12-months period beginning on February 2010, at Centro Médico Docente La Trinidad, Department of Gastroenterology, Caracas-Venezuela. Colonoscopies with Olympus optic magnifying colonoscope 160 Z and NBI were

performed by three independent endoscopists. A fourth endoscopist of Porto Alegre-Brazil from the Department of Gastroenterology of FUGAST received the electronic files of the 54 cases in a digital image filing system. All with training in NBI and FICE.[8] Original TVP classification[7] was used with magnifying NBI, formerly described with magnifying FICE (Fig. 1). For investigators 1 to 3 the initial training in the correct identification of proposed TVP was provided during a worldwide multicenter interobserver validation, consisting of a set of 41 electronic images of colorectal lesions with pathologic support.[8] Examples of every type of TVP using magnifying FICE from the provided training set (Fugast, Porto Alegre-Brazyl) were also enclosed and compared to those obtained with magnifying NBI at Centro Medico Docente La Trinidad (Caracas-Venezuela) (Figs. 2-8). Using random numbers, these 54 pictures were allocated to readers 1 to 4.

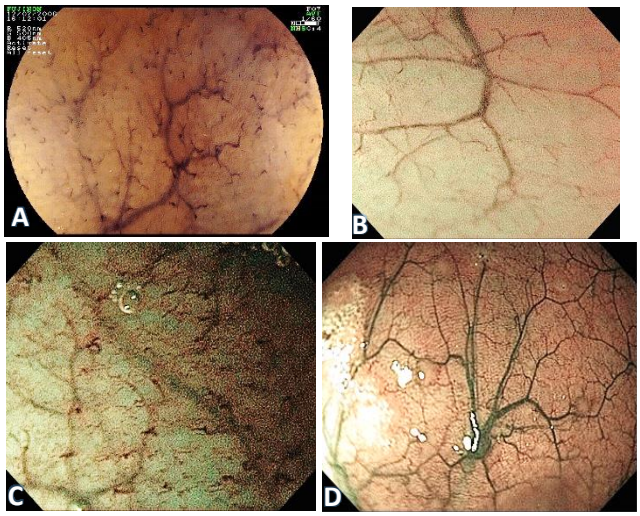

Figure 2. A) Colon normal vascular pattern (TVP I): Magnifying FICE. **B)** Colon normal vascular pattern, 50% magnifying NBI. **C)** TVP I, 100 % Magnifying NBI. **D)** Colon normal vascular pattern, NBI without magnifying.

The Paris Consensus on Macroscopic-Endoscopic classification was the guideline to typify colorectal lesions.[9] An open biopsy forceps 8 mm long was used to assess the size of the lesion.

Examples of every type of NBI magnification imaging using TVP are also provided (Figs. 2-8). Advanced cancers were sent to surgery. All other lesions were endoscopically removed with biopsy forceps, polypectomy or endoscopic mucosal resection and examined by a single pathologist.

The diagnostic accuracy of the different TVP's was determined in reference to the histopathological diagnosis, in terms of neoplasia or no neoplasia and adenoma with low/high grade dysplasia vs. deeply invasive adenocarcinoma. Interobserver agreement in reference to TVP was recorded. Specificity, sensibility, positive (PPV) and negative (NPV) predictive values to assess the neoplastic or non neoplastic nature of the lesion were determined, as well as to determine the presence of low/high grade dysplasia adenoma or invasive adenocarcinoma

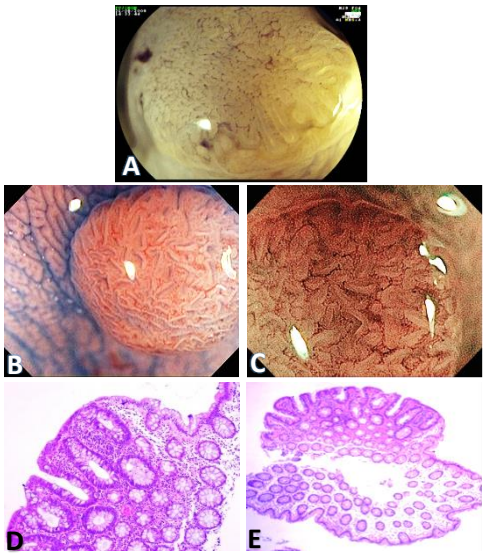

Figure 3. A) 0-Is (sessile) polyp, white light. **B)** Magnifying FICE ,TVP III. **C, D)** 0-Is polyp Magnifying & Indigo carmin, Magnifying NBI TVP III. **E)** Tubular adenoma, low grade dysplasia.

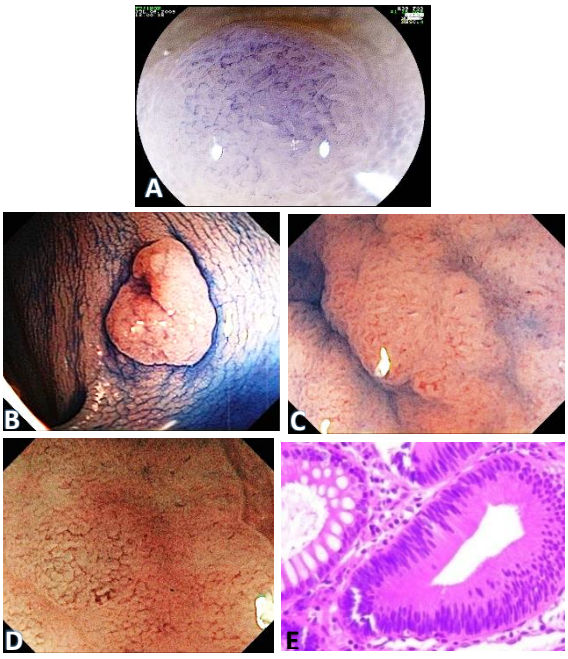

Figure 4. A) Flat Polyp 0-IIa Magnifying FICE, TVP III. **B)** Flat polyp 0-IIa, Indigo Carmin & white light. **C)** Magnifying & Indigo Carmin. **D)** Magnifying NBI, TVP III . E) Tubular adenoma, low grade dysplasia.

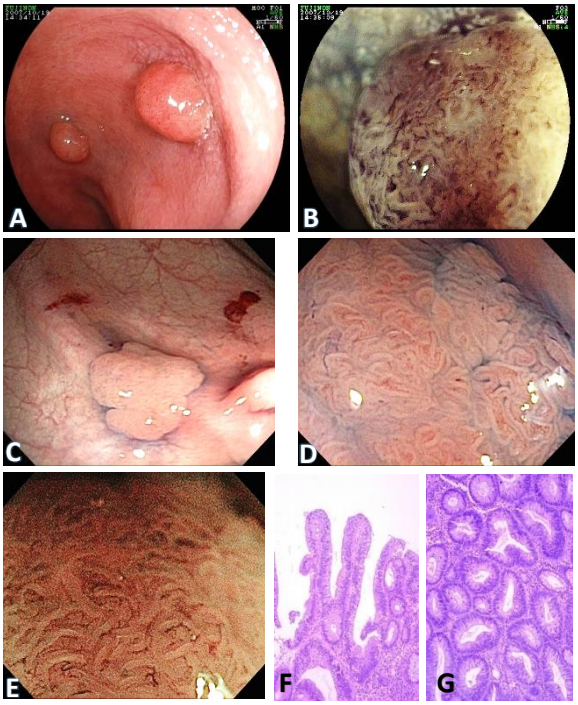

Figure 5. A) 0-Is (sessile) polyp, White light. **B)** Magnifying FICE ,TVP III. **C)** Flat polyp 0-IIa, residual lesion from a big 0-Is (sessile), white light & Indigo Carmin. **D)** Magnifyng & Indigo Carmin. **E)** Magnifying NBI, TVP III. **F-G)** Tubulo villous adenoma.

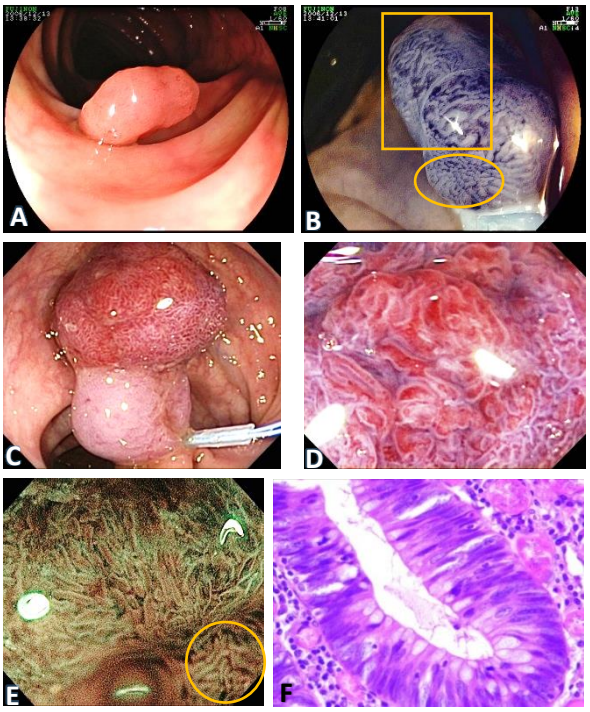

Figure 6. A) 0-Isp (sub pedunculated) polyp, white light. **B)** Magnifying FICE, Type III (oval outline) & IV (square outline) TVP in the same lesion. Type IV TVP applies for the whole lesion. **C)** 0-Ip (pedunculated) polyp, white light. **D)** Magnifying NBI & Indigo Carmin. **E)** Magnifying NBI, Type IV TVP (circle outline). **F)** Tubulo villous adenoma, high grade dysplasia.

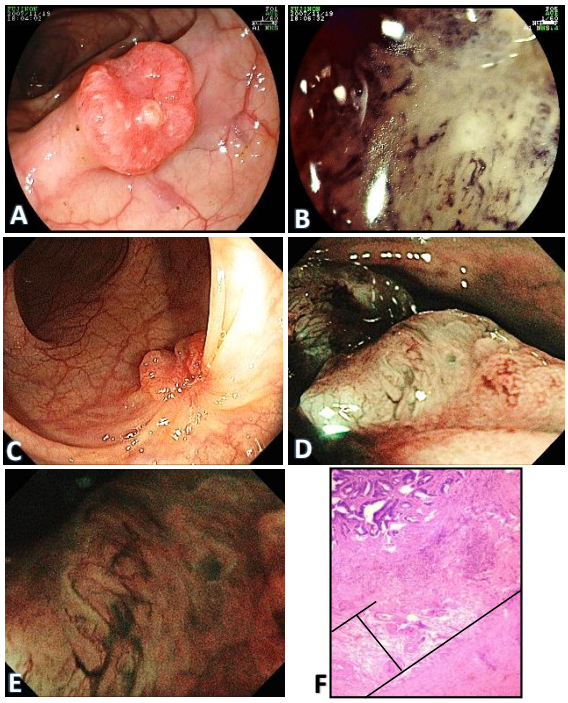

Figure 7. A) Small flat tumor, with deep central depression, white light. **B)** Magnifying FICE, type V TVP. **C)** Sessile type tumor, partial polipectomy revealed carcinoma, white light. **D, E)** Magnifying NBI, type V TVP. **F)** Colectomy.Sm3 (sub mucosal deepest portion) adenocarcinoma, no metastatic lymph nodes. Short vertical line: submucosa

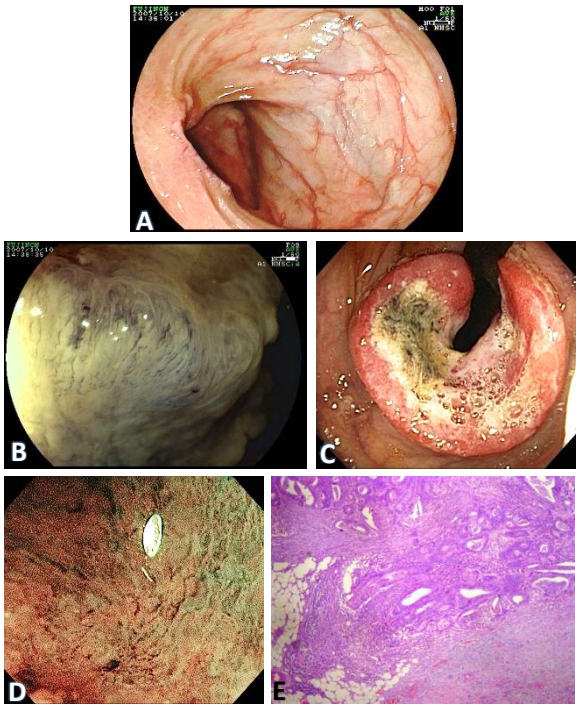

Figure 8. A) White light. Flat tumor with folds convergence. **B)** Magnifying FICE, type V TVP. **C)** White light. Tumoral stenosis on transverse colon. **D)** Magnifying NBI, type V TVP. **E)** Colectomy, Adenocarcinoma whit sub serosal invasion, Lymph nodes (+)

RESULTS

Fifty-four lesions were detected in 31 patients. Sizes ranged from 5 to 60 mm. According to the Paris consensus, 27 were nonpolypoid lesions (23 0-IIa 2 0-IIc 2 LST), 18 were polypoid (16 0-Is 2 0-Ip), six were advanced adenocarcinomas and three were mucosal erosions. The pathologic examination showed seven hyperplastic polyps, 36 low-grade adenoma, two high-grade adenoma, six deep invasive adenocarcinoma (invasion to the deepest layer of the submucosa or beyond), and three non-specific inflammatory conditions.

Considering TVP from I to V to predict neoplasia vs. no neoplasia, TVP's were divided into categories I or II as no neoplasia, and III to V as neoplasia. These figures provided 0.943 ± 0.013 Specificity, 0.825 ± 0.126 Sensibility, 0.960 ± 0.029 PPV, and 0.765 ± 0.062 NPV (Table 1).

Table 1. Presence/absence of neoplasia, determined by normal, inflammatory or hyperplastic conditions vs. adenoma or carcinoma from colon and rectum related to pathology.

Presence/absence of neoplasia	
Sensibility	0,825 ± 0,126
Specificity	0,943 ± 0,013
PPV	0,960 ± 0,029
NPV	0,765 ± 0,062

The diagnosis of TVP by each investigator in relation to histopathology in shown in Table 2.

The overall interobserver agreement determined a kappa value of 0.84259259 (0.63-0.84) (Table 3).

Of all inflammatory conditions (No=3), one investigator considered four cases as type I TVP, one of them corresponding to a hyperplastic lesion, although a non neoplastic condition. In lesions considered as invasive adenocarcinoma (N=6), one investigator considered five cases to be type V TVP, and the other one was allocated to type IV TVP. The rest of the investigators considered the six cases of invasive adenocarcinoma to be type V TVP.

Table 3. Overall kappa agreement.

Overall agreement (kappa)	0.84259259 (0.63-0.84)

Of the two high-grade adenoma, three investigators allocated them to type IV and the other investigator considered one of the cases as early adenocarcinoma (Invasion of the deepest layer of submucosa, Negative Lymph Nodes) and allocated it to type IV TVP. The highest disagreement was found in this TVP (Table 1).

It is remarkable that no benign condition (inflammatory or hyperplastic) was considered to be type III to V TVP.

DISCUSSION

The TVP classification, initially described in 2009,[7] was submitted to worldwide validation on 2010. This validation provided a set of images aimed to train endoscopists in these five types of vascular patterns (VP) of colorectal lesions, including the shape of normal capillaries.[8]

Most available classifications of VP of colorectal lesions have been developed using magnifying NBI, and the majority of them stress the shape of the capillaries as a key to predict the pathology.[4-6,12] Despite the existence of several classifications and investigative groups, all of them agree on the loss of the normal VP as a feature to be considered with special attention. At present, a NBI International Colorectal Endoscopic (NICE) classification as an international classification system is on the way.[4]

TVP is intended to evaluate the capillary shape exclusively, and does not emphasize the capacity to reproduce the mucosal pattern, as other investigators have done.[10]

Table 2. Answers of investigators 1-4.

	Researcher 1 TVP						Researcher 2 TVP						Researcher 3 TVP						Researcher 4 TVP					
Histology	I	II	III	IV	V	Total	I	II	III	IV	V	Total	I	II	II	IV	V	Total	I	II	III	IV	V	Total
A	3					3	3					3	3					3	3					3
B		4	3			7		5	2			7		5	1	1		7	1	6				7
C		3	32	1		36		2	34			36		3	30	3		36		2	33	1		36
D			1	1		2				2		2				2		2			1	1		2
E					6	6					6	6					6	6				1	5	6
Total	3	7	36	3	6	54	3	7	36	2	6	54	3	8	321	6	6	54	4	8	34	3	5	54

A: Normal vs. Inflammatory histology; B: Hyperpastic lesions; C: Low-grade adenoma: D: High-grade adenoma; E: Invasive adenocarcinoma (deepest submucos layer).

The high accuracy values provided by NBI magnifying technology regarding histopathology to achieve TVP classification, formerly described with Fice magnifying technology,[7] are worth of notice to predict tumor vs. no-tumor and to subdivide low-grade adenoma vs. deeply invasive adenocarcinoma. This last possibility is of paramount importance, considering deep invasion to the submucosal layer (more than 1,000 µm).[3,11] The therapeutic implications are of great value: endoscopic vs. surgical treatment.

The short learning curve of TVP is also a valuable feature and, in terms of training, proved to be useful. It is our impression that a complicated system for classifying the vascular pattern of colorectal tumors could pose a difficulty for massive use.

To the best of our knowledge, this is the first classification using magnifying FICE to describe five types of VP, which affords an excellent tool at the time of making a decision about the therapeutic procedure.

It is our impression that, in the future, the I to V mucosal pattern described by Kudo SE[11] with Indigo Carmine dye and magnifying colonoscope and the VP using either NBI or FICE[12] could be used in combination to increase the rationale of endoscopic diagnosis and therapeutic procedure in a massive and standardized practice. A practice tip could be to use magnifying NBI or FICE first, and then switch to white light and add Indigo Carmine to avoid interference in the evaluation of the VP.

This pilot study shows that a previous TVP classification, initially designed with Fujinon FICE imaging magnification can be reproduced with Olympus Narrow-band imaging magnification. Since no VP classification has proven yet to be the dominant in predicting the histology of colorectal lesions, a larger scale trial using both systems would be the best way to attain a more universal classification. As a pilot study, the present classification proved to be useful using both technologies to achieve a good prediction of the histopathology.

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