Structural enhancement and video endoscopy: Results of a large prospective comparative study

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Summary

Introduction. — The structural-enhancement (SE) function electronically improves the video-endoscopic signal of Olympus processors (EXERA CV-160 or greater), enabling an increase in relief that may help in the detection of flat or ulcerated and raised lesions, especially those of small size. We assessed the diagnostic impact of this technique in the screening of lesions during basic video colonoscopy.

Methods. — Maximum-level SE was programmed into processors on alternate weeks, and endoscopy dates were planned by an assistant unaware of the SE schedule, thus ensuring randomization. The endoscopists—senior practitioners with 3–29 years of digestive endoscopy practice—were informed of the experiment >3 weeks before it began and were not told about it again either before or during the study. This was to ensure that endoscopy examinations were performed without over-awareness of the technical conditions. GIF-100 to -160 Olympus endoscopes were used.

Results. — During the study, 606 patients underwent upper digestive video-endoscopy, 305 with and 301 without the use of the SE function. Of 645 patients who underwent video colonoscopy, 593 were included in the study and 52 were excluded due to poor cleansing (8%); of those included, 330 were analyzed with and 263 without the SE function. We observed no differences in the detection of lesions (small or large) by either upper digestive endoscopy or video colonoscopy.

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Conclusion. — This is the first study comparing video-endoscopy diagnosis with or without SE during upper digestive endoscopy and colonoscopy. The SE function available on Olympus video-endoscopy processors had no impact on the detection of lesions, not even on those of very small size. © 2009 Elsevier Masson SAS. All rights reserved.

Résumé

Introduction. — Le rehaussement de structure est un procédé de traitement électronique du signal d’image vidéo-endoscopique disponible sur les récents processeurs de marque Olympus (série Exera CV 160 and suivantes) qui permet d’augmenter les reliefs. Il semble pouvoir aider à mieux détecter les lésions planes, ulcérées et surélevées, en particulier lorsqu’elles sont de petite taille. Cette étude avait pour but d’évaluer l’impact de ce procédé technique sur le dépistage des lésions au cours des vidéo-endoscopies de routine.

Méthodes. — Pendant l’étude, le rehaussement de structure (à son niveau de réglage maximum) était programmé sur les processeurs une semaine sur deux. Une secrétaire planifiait les vidéo-endoscopies sans connaissance du type de réglage du rehaussement de structure sur les processeurs lors de la date prévue. Les endoscopistes, tous seniors (trois à 29 ans de pratique endoscopique) avaient été informés sur l’essai plus de trois semaines avant son début et n’étaient pas ré-informés pendant sa réalisation, afin qu’ils l’oublient et que les examens endoscopiques soient réalisés sans qu’ils aient conscience de leurs conditions techniques. Les endoscopes Olympus étaient de type GIF100 à 160.

Résultats. — Pendant l’étude, 606 patients ont bénéficié d’une vidéo-endoscopie digestive haute, 305 avec et 301 sans rehaussement de structure. Parmi les 645 patients ayant bénéficié d’une vidéo-coloscopie, 52 étaient exclus pour mauvaise préparation (8 %), et 593 étaient inclus dans l’étude, 330 avec et 263 sans rehaussement de structure. Aucune différence n’était observée dans les taux de détection des lésions, de grande ou de petite taille, en endoscopie digestive haute ou basse.

Discussion et conclusions. — Au cours de cette première étude comparant les taux de diagnostics vidéo-endoscopiques avec ou sans rehaussement de structure, au cours des endoscopies digestives hautes et des colonoscopies, le rehaussement de structure disponible sur les vidéo-endoscopies Olympus n’a pas démontré d’impact sur la détection des lésions, en particulier de petite taille. 

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Introduction

The structural-enhancement (SE) function available on Olympus processors (EXERA CV-160 or greater) allows the electronic manipulation of video-endoscopy signals and enables an increase in relief. It may help to detect ulcerations and flat or raised lesions, especially those of small size. It is currently used in association with the zoom and narrow-band imaging (NBI) functions. However, its specific contribution to the diagnosis of small lesions has not been previously assessed. For this reason, we evaluated the diagnostic impact of the technique on the detection, but not characterization, of lesions during basic video endoscopy.

Methods

The study was conducted at the Bordeaux University Hospital (Haut-Lévêque Hospital) from 22 April to 26 July 2002 and from 9 September to 7 October 2002 (upper digestive endoscopies and colonoscopies), and from 1 April to 30 July 2004 (video colonoscopies only). The SE function (at maximum level) was programmed into the processors on alternate weeks. Endoscopy dates were planned by an assistant who had no knowledge of the SE schedule to ensure proper randomization. The endoscopists — all senior practitioners (with 3—29 years of digestive endoscopy practice) — had been informed of the experiment more than 3 weeks before it began and were not told again either before or during the study. Only one of the endoscopists was always aware of whether or not the SE feature was activated during each given week.

The Olympus video endoscopes were GIF-100 and GIF-Q140 eso-gastro-duodenoscopes, and CF-130I, Q140, Q145, Q160ZI and 2T160I colonoscopes. Endoscopy performed with optical endoscopes (mostly emergency endoscopy in intensive care units) was excluded from the study.

False-positive lesions were endoscopically shown to be polypoid abnormalities with normal tissue on histopathological examination. These false-positive lesions were all reviewed after additional step sections were taken for confirmation.

The endoscopy and anatomopathological reports were investigated at the end of the study. The following information was recorded:

- patient’s identity, date and type of endoscopy (upper digestive endoscopy, colonoscopy or sigmoidoscopy);
- SE function used or not;
- bowel preparation (colonoscopy);
- endoscopy findings — in particular, whether lesions were <10 mm (erosions and ulcerations, polyps and flat lesions,
Table 1  Impact of structural enhancement (SE) on the diagnosis of lesions on upper digestive video endoscopy.

<table>
<thead>
<tr>
<th>Lesions &lt;10 mm</th>
<th>With SE</th>
<th>Without SE</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lesions &lt;10 mm and &gt;10 mm</td>
<td>45 (15)</td>
<td>49 (16)</td>
<td>&gt;0.70</td>
</tr>
<tr>
<td>Lesions &gt;10 mm</td>
<td>149 (49)</td>
<td>150 (50)</td>
<td>0.80</td>
</tr>
<tr>
<td>Normal examination</td>
<td>92 (30)</td>
<td>81 (27)</td>
<td>&gt;0.40</td>
</tr>
<tr>
<td>Total (n)</td>
<td>305</td>
<td>301</td>
<td></td>
</tr>
</tbody>
</table>

Data are expressed as n (%).

Table 2  Impact of structural enhancement (SE) on the diagnosis of lesions on video colonoscopy.

<table>
<thead>
<tr>
<th>Lesions ≤10 mm</th>
<th>With SE</th>
<th>Without SE</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lesions &gt;10 mm or diffuse</td>
<td>139 (42)</td>
<td>111 (42)</td>
<td>0.00</td>
</tr>
<tr>
<td>Normal colonoscopy</td>
<td>115 (35)</td>
<td>84 (32)</td>
<td>&gt;0.40</td>
</tr>
<tr>
<td>Total (n)</td>
<td>331</td>
<td>262</td>
<td></td>
</tr>
</tbody>
</table>

Colonoscopy

Of the 645 consecutive patients who underwent video colonoscopy, 52 were excluded due to poor colonic cleansing (8%), leaving 320 men (median age: 57 years, range 13—93) and 273 women (median age: 54 years, range 14—98). Of these patients, 479 had total colonoscopy, 35 had incomplete colonoscopy due to stenosis or mechanical difficulties in the progression and 79 had flexible sigmoidoscopy. A total of 330 patients were investigated using the SE feature and 263 were investigated without it (Table 2). Again, no differences were observed between the two groups.

Discussion

Availability of the SE function offers the possibility of improving the visualization of small or flat lesions and of increasing the diagnostic performance of video endoscopy. Indeed, it may even be a reason to switch to Olympus processors (models 160 or greater). This was the first comparative study aiming to evaluate the usefulness of the electronic SE signal.

Despite the study being carried out in a university teaching hospital, our findings represent ordinary practices associated with digestive endoscopy. Upper digestive endoscopy is mostly performed for gastroesophageal reflux, heartburn and the investigation of chronic hepatopathology. Colonoscopy is mainly performed because of a personal or family history of colorectal polyps or cancer, a positive fecal blood test, hematochezia, abdominal pain, chronic diarrhea, or a personal history or exploration of inflammatory bowel disease. Sigmoidoscopy is performed for the same indications, but mostly in the elderly (age >80 years). Thus, given the large number of endoscopies performed under the usual conditions, our study appears to reflect digestive endoscopy in a "real-life" context.

In our study, the prevalence of neoplastic lesions (adenoma and cancer) that were <10 mm was 15.5%. In a large Italian study [1] in which 2005 colonoscopies were reviewed, neoplastic lesions were observed in 381 patients, 56 of which were large ulcerated cancers. Thus, the prevalence of small lesions was 16%. A German study [2], which reviewed 401 colonoscopies, compared conventional and NBI endoscopy: the prevalence of adenoma was 17% and 23% with conventional and NBI endoscopy, respectively, whatever the size of the lesions.

vascular and other lesions), diffuse or >10 mm (cancer, polyps and villous lesions, inflammatory lesions and diverticula, as well as diffuse structures, esogastric varicose veins and inflammatory abnormalities); • histopathological results (such as adenoma, hyperplastic polyps and cancer).

Statistical analyses were conducted per patient, not per lesion, and the most medically significant lesion was selected for each investigation: for example, cancerous lesions were chosen if adenocarcinoma and adenoma were both observed in the same patient. During interpretation, hyperplastic polyps, neoplastic lesions (adenoma, adenocarcinoma) and ulcers (upper digestive endoscopy) were also considered to be more important than "diffuse" lesions if both were present in the same patient. We used the Chi-square tests for percentage comparisons.

Results

Upper digestive endoscopy

An upper digestive video endoscopy was carried out in 606 consecutive patients — 344 men (median age: 54 years, range 16—87) and 262 women (median age: 54 years, range 15—92) — of whom 305 were with, and 301 were without, SE (Table 1). No differences were observed between the two groups. Barrett’s metaplasia was revealed in 42 patients by endoscopy, 29 of whom underwent biopsy to confirm the diagnosis. The diagnosis was confirmed in 77% of the examinations with SE and in 75% of those without SE.
of the lesion. Thus, the prevalence of observed lesions in our study was similar to those for neoplastic lesions in other non-selective and prospective studies.

As our statistical analyses were carried out per patient and not per lesion, our findings for colonoscopy and upper digestive endoscopy can be considered within a clinical perspective. This includes whether or not the patient had to be monitored after resection of adenoma, and whether or not adenocarcinoma or ulcer was diagnosed. We then compared the prevalence of diagnoses of the most medically significant lesions — but not the number of lesions observed per patient — with and without the use of the SE function. Thus, clinical relevance was selected over technical performance.

In the present study, endoscopy was performed with and without SE: using 2-week (A and B) blocks, if endoscopy was enhanced in week A, then no enhancement was used in week B. For the process of randomization, patients were allocated a date for endoscopy by an assistant blinded to the SE schedule in place that week. Although no individual randomization using, for example, a random-number table was carried out, the selection for enhancement or not — albeit imperfect — was nevertheless truly random and involved no time-based comparison of the two patient cohorts.

When the study began, the duration of the endoscopy examination was not noted on the reports. However, the large number of patients reviewed suggests that the mean examination times were similar between the two groups.

In addition, it is not certain whether or not the processors remained activated for enhancement throughout the entire duration of the program: endoscopists may have altered the SE level if they were unaware that a study was ongoing. This was one of the major methodological weaknesses of the study. We did not wish to have the endoscopy nurses intervene in the regulation of the SE feature, as they are already frequently involved in the diagnosis through verbal or non-verbal reactions when viewing the endoscopy images. However, the large number of endoscopies reported in this study, and the similar and normalized changes observed in the two groups, may have compensated for the statistical effects of such incidental events.

As no other studies have investigated the use of imaging enhancement in video colonoscopy using the SE function of the processors, we are not able to compare our findings. Several studies were carried out after the introduction of the Olympus CV-160 processors, but the precise use of the SE feature has only been reported in one previous study [3]. In studies involving magnification [4,5], the SE function may have been used during chromoendoscopy [1,3,6—9] or NBI endoscopy [2,9,10] without being mentioned in the reports. Nevertheless, we could find no published reports of these techniques with or without the use of the SE feature for comparison.

Although the images collected in the present study have improved contrast (Figs. 1 and 2), our results for the screening of lesions were no better than those without structural enhancement. Consistent with the recently published findings with NBI [11] and wide-angle [12] colonoscopy, the use of the SE function does not appear to have any clinical relevance for digestive endoscopy. The negative results of our study require confirmation by further trials, which should include randomization per patient and take into account the number of lesions per patient. Furthermore, the technique requires further evaluation in the characterization of lesions in combination with other technical improvements of video endoscopes.

**Conflicts of interest**

No potential conflicts of interest relevant to this article were reported.

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References


