

# The value of abdominal ultrasound in the diagnosis of colon cancer

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## ABSTRACT

**Introduction:** colon cancer is one of the main causes of cancer death. Diagnosis requires the examination of the entire large bowel by means of radiological or endoscopic techniques. Many patients suspect of colon cancer are referred for colonoscopy but nevertheless this suspicion is not confirmed after endoscopic examination. The objective of this study is the evaluation of the reliability of abdominal ultrasound in the diagnosis of these tumors.

**Material and method:** we selected patients suspect of colon cancer referred to the endoscopy unit for a colonoscopy. An abdominal ultrasound was carried out on all patients prior to the endoscopy. Considering the endoscopic examination as a gold standard, the sensibility, specificity, positive predictive value (PPV) and negative predictive value (NPV) of the ultrasonography were evaluated. Likewise, a series of analytical and clinical parameters were evaluated, in an attempt to establish associated factors of a colon cancer. The statistical analysis was carried out by means of the statistical package SPSS 12.0 for Windows.

**Results:** 145 patients were included in the study (56.6% males) with an average 66.72 years of age (22-89). A cancer was diagnosed in 42 cases (28.9%). In the diagnosis of colon cancer, abdominal ultrasound presents a sensitivity of 79.06%, a specificity of 92.15%, a PPV and a NPV of 80.9% and of 91.2%, respectively. Excluding from the analysis lesions of the rectal ampulla, which cannot be adequately evaluated by means of ultrasound, the figures for sensitivity, specificity, PPV and NPV increase to 91.8, 92.1, 80.9 and 96.9% respectively. The univariate analysis showed that an age over 65 years and the presence of microcytosis are associated to a greater risk of colon cancer while after multivariate analysis only the presence of microcytosis resulted to be an independent predictive factor of cancer.

**Conclusions:** abdominal ultrasound presents high sensitivity, specificity, PPV and NPV in the diagnosis of colon cancer. The combination of an ultrasonography and a rectoscopy permits us to rule out the presence of a colorectal carcinoma. In patients with microcytosis of 65 years and over, if there is strong clinical suspicion, a negative ultrasound may not be sufficient to rule out a colorectal neoplasia.

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## INTRODUCTION

Colorectal carcinoma (CRC) is the most frequent gastrointestinal neoplasia, representing approximately 60% of the total (1,2). It presents a lethality rate lower than that of other tumors, but its high frequency converts it into one of the greatest causes of mortality (1-3). Within the range of digestive tumors it is only surpassed by the mortality of liver cancer and stomach cancer in males and of gastric cancer in women (3,4). The risk of suffering this type of tumor increases with age (1,2), in males (1,2,4,5) and in black people (1,2). In our country these tendencies appear to be maintained, the male/female ratio being 1.64 (1-3). Some studies suggest an association of CRC to the syndrome of insulin resistance and a sedentary lifestyle (6,7). Smoking (6,8,9), a family history of CRC and certain nutritious habits, such as the excessive consumption of fatty foods, may also be considered as risk factors (6).

Large geographical variations in relation to the incidence of CRC exist, being 15-25 times higher in the developed countries (10). In Europe, the incidence and the mortality associated to CRC have increased ever so slightly or even can be seen to be reduced thanks to the implementation of screening programs (6,11,12). Nevertheless, in countries such as Greece, Spain and Portugal mortality has continued to grow since adequate screening programs do not yet exist (11). Spain is among the group of countries with the highest mortality rates (3).

Colon cancer is clinically detected only in very advanced phases, when the prognosis is already not favorable (13). Therefore, early diagnosis is of vital importance. For the moment the gold standard for diagnosis is still the colonoscopy, which also plays a very important preventive role in the removal of precursory lesions (14-16). The tumor markers are of little diagnostic value (17), being more useful in the monitoring of tumors and in the diagnosis of family history. For the diagnosis of CRC the examination of the entire large bowel by means of endoscopic or radiological techniques is obligatory (18). Radiological techniques based on obtaining images by means of CT scan or MRI permit a study of the extension of the illness (18,19). The barium enema (20) and especially the double-contrast enema (21,22) are alternatives to the colonoscopy, reaching levels of sensitivity of over 90%. The virtual colonoscopy (23-31) is also a good alternative, although its sensitivity in the detection of smaller lesions has not yet been sufficiently tested. The value of abdominal ultrasound in the diagnosis of CRC has already been established in various studies, however, all involving few patients (32-35). Sonographic findings such as an irregular and hypoechoic thickening of the colon wall and an irregular contour, as well as the loss of stratification in layers of the wall, suggest the diagnosis (33).

Many patients are remitted to the Endoscopy Unit for colonoscopies with a suspected diagnosis which is later not confirmed. The objective of this study is to prospectively evaluate the sensitivity and the specificity of abdominal ultrasound in the diagnosis of colon cancer.

## MATERIAL AND METHOD

### Selection of patients

We selected 150 patients with suspected CRC who were remitted consecutively to the Endoscopy Unit for colonoscopy. These patients were recruited in two different periods and in two different centers: from September 1 to December 31, 2003 in the University Hospital Juan Canalejo, Coruña and from July 1 to October 31, 2004 in the University Hospital Xeral Cies, Vigo. This was entirely due to a change of workplace of the first author of the study. Patients who had already undergone endoscopic or radiological examination of the colon were excluded, as were, those patients on whom a complete colonoscopy could not be carried out.

### Preparation of the patients

All patients underwent conventional preparation was for colonoscopy consisting of liquid diet the afternoon previous to the procedure, a polyelectrolytic solution with polyethylenglicol (Bohm Solution) and two enemas,

one the previous night and another in the morning of the examination.

## Method

Percutaneous abdominal sonography was practiced on all patients before the colonoscopy; both examinations were carried out on the same day in the case of the outpatients, or during the same stay in the case of the hospitalized patients. All the sonographic examinations were carried out by the same observer using the Hitachi EUB-525 and Toshiba Nemio 10. Subsequently, endoscopic examinations were carried out by different endoscopists of the Endoscopy Unit of the University Hospital Juan Canalejo in the first period and of the University Hospital Xeral Cies in the second period, using an Olympus GIF 100 and a Fujinon EC-250WL.

The ultrasonography was carried out according to conventional procedure, carefully examining the entire abdomen. The ultrasound was considered positive when in some of the locations the characteristic image of hypoechoic thickening with loss of mobility and of stratification in layers of the wall was depicted (Fig. 1).



Fig. 1.- We can observe a hypoechoic thickening of the colon wall, whose diameter is of around 15 mm; in addition, the loss of the stratification in layers and the mobility of the intestinal loop are evident.

*En la imagen se objetiva un asa de pared muy engrosada, por encima de los 15 mm, con una pérdida total de la estructura en capas de la pared y de la movilidad y compresibilidad del asa.*

## Variables studied

In the patients included in the study the demographic characteristics, the clinical characteristics of the patients, the procedure indications, the figures for hemoglobin and of hematocrit, the Mean Corpuscular Volume (MCV), the result of the sonography, the endoscopic findings (type of

lesion, location, obstructing or not) and the final diagnosis of the patient have been evaluated. Considering the endoscopy as the gold standard in the diagnosis of CRC, the sonographic findings were classified as true positive and negative, false positive and negative.

### Statistical analysis

The statistical study was carried out by means of the statistical package SPSS 12.0 for Windows. Descriptive statistics of the above mentioned variables has been carried out. Subsequently the levels of sensitivity, specificity, positive predictive values (PPV) and negative predictive values (NPV) for the ultrasound in the diagnosis of colorectal carcinoma were calculated manually. Finally, a search for factors associated to a diagnosis of malignancy was carried out among all the variables described in the previous section. The comparison of qualitative variables was carried out based on the Chi squared test. The quantitative variables were transformed into qualitative variables and comparison was also carried out by means of the Chi squared test. The multivariate analysis was carried out by means of a logistic binary regression. The results were considered statistically significant with a value of  $p < 0.05$ .

### RESULTS

Of the 150 patients selected only 145 (96.6%) could be finally included. The 5 remaining patients were excluded because the colonoscopy could not be carried out or this could not be completed to caecum.

The average age of the patients included was of 66.72 years (ranging from 22 to 89 years). A 62.1% of the patients were over 65. The group was composed for 82 males (56.6%) and 63 women (43.4%).

The clinical picture of the patients on hospitalization was of digestive hemorrhage in 36.6% of patients, altered bowel habit in 18.6%, and severe anemic syndrome in 14.5%. The remainder of the patients consulted for other less frequent clinical manifestations (Table I). The patients presented an average hemoglobin of 11.29 g/dl (ranging from 3.9 to 16.7), a hematocrit of 33.7% (14.4-47.6) and a MCV of 84.1 (56-110). Table I shows the distribution of the hemoglobin, MCV and hematocrit counts.

The ultrasonographic examination was normal in 83 cases (57.2%), while in 62 cases (42.8%) this was pathological. The image compatible with colorectal carcinoma, was established in 42 cases (29%). In 57.1%, the images were located at the level of the left colon, in 38.1% at the right colon, in 14.2% at the left hypochondrium and in 4.6% at the level of the right hypochondrium. In 34 patients the findings were confirmed by the endoscopy (true positive), while in 8 cases, the endoscopy did not corroborate

**Table I. Summary of the demographic variables, analytical parameters and clinical manifestations of the patients included in the study**

Characteristics of the patients	Number of patients (%)
<i>Age</i>	
< 65 years	37.9
> 65 years	62.1
<i>Sex</i>	
Male	56.6
Female	43.4
<i>Clinical symptoms</i>	
Digestive hemorrhage	36.6
Altered bowel habit	18.6
Anemic syndrome	14.5
Abdominal pain	12.4
Combination of the above	9.0
Other manifestations	8.8
<i>Hematocrit level</i>	
< 25	13.8
25-35	38.2
> 35	47.9
<i>Mean corpuscular volume</i>	
< 78	21.5
> 78	78.5
<i>Hemoglobin (g/dl)</i>	
< 8	13.9
8-11	28.5
> 11	57.6

the sonographic diagnosis (false positive). On the other hand, in 94 patients in which the sonography was negative, the colonoscopy did not locate neoplastic lesions (true negative), while in 9 cases in which the sonography was not conclusive, the colonoscopy revealed the presence of colorectal neoplasia (false negative). Thus, we conclude that abdominal ultrasound presents a sensitivity of 79.06%, a specificity of 92.15%, a PPV of 80.9% and a NPV of 91.2%. These results are summarized in table II. In all cases the ultrasonography as much as the colonoscopy detected lesions, the location of the same in the ultrasound was exact, identifying the colonic segment affected.

The colonoscopy did not detect any lesion in 41 patients (28.3%), while it did describe pathological findings in 103 cases (71.7%), diagnosing a total of 43 (29.7%) malignant neoplasias. In 29 cases (67.4%) the lesions significantly obstructed the lumen of the colon, and in 14 cases (32.6%) they were lesions of a smaller size. In the 8 cases considered as false negative, 6 lesions (75%) were located in the rectum and 6 of them (75%) were lesions

**Table II. Summary of the results of the sonographic study of patients with suspected CRC**

	Patients with CCR	Patients without CCR	
Positive ultrasound	34	8	42
Negative ultrasound	9	94	103
	43	102	145

We can deduce from the data that abdominal ultrasound presents a sensitivity of 79.06%, a specificity of 92.15% a PPV of 80.9% and an NPV of 91.2%.

of a small size, having no effect on colonic transit. The two obstructing lesions not visualized in the ultrasonography were located in the rectum. On the other hand, in the patients in which a colon cancer was identified in the ultrasound and the colonoscopy did not confirm these findings, in 3 cases (33.3%), it was a sigmoid colon, extraordinarily spastic in relation to a severe diverticulosis of sigma, in 5 cases (55.5%), an inflammatory stenosis or ischemic, and in 1 case the infiltration of the sigmoid colon by a neoplasia of gynecological origin.

If we consider that the rectal ampulla cannot be evaluated by means of percutaneous abdominal ultrasound and we exclude the 6 rectal lesions from the analysis, we are able to affirm that the sensitivity, specificity, PPV and NPV of the ultrasound in the diagnosis of the colorectal carcinoma situated above the rectosigmoid junction are of 91.8, 92.1, 80.9 and 96.9% respectively.

In the statistical analysis carried out to establish factors predictive of colorectal carcinoma, the following variables were included: age, sex, hemoglobin, hematocrit and MCV counts, clinical presence of low digestive hemorrhage, constitutional syndrome, altered bowel habit and results of the sonographic study. The quantitative variables, age, hemoglobin, hematocrit and MCV counts were transformed into categorical variables with 2 possible values (Table III). We observed that 34.4% of the patients of over 65 years of age presented colon cancer, compared to only 21.8% of those of less than 65 years of age ( $p = 0.049$ ); 51.6% of the patients who presented macrocytosis ( $MCV < 78$ ) suffered colon cancer while only 23.9% of those with normal MCV presented a positive colonoscopy ( $p = 0.004$ ). Finally, while 81% of patients with a positive sonography presented colon cancer, only 8.7% of the patients with negative sonography presented it ( $p < 0.0001$ ). In the multivariate analysis, carried out by means of a logistic binary regression, only the positive ultrasonography and the presence of microcytosis in blood tests were shown as independent factors predictive of a colonic neoplasia, with an odds ratio of 9.26 (IC 95% 4.8 to 17.5) and of 2.16 (IC 95% 1.34 to 3.46) respectively.

## DISCUSSION

Although the studies carried out to date are scarce involving few patients, some data on the high sensitivity of abdominal ultrasound in the diagnosis of the colorectal

**Table III. Variables included in the univariate analysis**

Variables	Colorectal carcinoma (%)	p
<i>Age (years)</i>		
< 65	21.8	
> 65	34.4	0.049
<i>Sex</i>		
Male	25.6	
Female	34.9	0.272
<i>Low digestive hemorrhage</i>		
No	33	
Yes	24.1	0.492
<i>Hematocrit level</i>		
> 25%	29.3	
< 25%	33.3	0.486
<i>Constitutional syndrome</i>		
No	30	
Yes	28	0.981
<i>Altered bowel habit</i>		
No	31	
Yes	24.1	0.650
<i>Mean corpuscular volume</i>		
> 78	23.9	
< 78	51.6	0.004
<i>Hemoglobin</i>		
> 8 g/dl	29	
< 8 g/dl	35	0.604
<i>Positive ultrasound</i>		
No	8.7	
Yes	81	< 0.0001

We can observe that patients of over 65 years of age with microcytosis and with a positive ultrasound are present in significantly greater frequency.

carcinoma already exists. In their study Rutgeerts et al. (32) observed a high sensitivity of 95%, although accompanied by low specificity. Richardson et al. (33) obtained similar results, with a sensitivity of 96% and a specificity of 67%. On the contrary, Shirahama et al. (34) obtained a specificity of 90%. In our study of 145 patients where 43 tumors were diagnosed, the levels of sensitivity are lower than those published previously (79%) and the figures for specificity are congruent with the study of Shirahama (92%). Nevertheless, if we exclude the tumors located in the rectal ampulla, which cannot be evaluated adequately by means of abdominal ultrasound, we obtain a sensitivity practically equal to that of the other authors. As it is logical, the small-sized polypoid lesions that do not affect the intestinal lumen are not detected by ultrasonography, while lesions of greater size are easily visualized. Thus, Lim et al. (35) studied patients with intestinal obstruction, of neoplastic and of other origins, and with abdominal sonography gave the precise location and cause in most cases.

Only two studies compare the sonography with other techniques. Loftus et al. (36) in a study that includes only 7 patients with colon cancer, the conclusions of which are of little weight, considered the abdominal ultrasound

clearly superior to the CT scan. The ultrasonography presents a sensitivity and specificity of 100%, figures significantly higher than those obtained in other studies. Candia et al. (37) compared the hydrocolonic ultrasound with the double-contrast enema. The hydrocolonic ultrasound presents a lower sensitivity in the diagnosis of polyps of small size (80 vs. 92%) but greater specificity (100 vs. 92.8%); nevertheless, in the diagnosis of CRC it presents a higher sensitivity (96.8 vs. 90.6%) and the same specificity (100%). Both sensitivity and specificity are higher than those obtained for the conventional ultrasound.

In fact the hydrocolonic ultrasound, carried out after the retrograde instillation of a water enema, permits the examination of the entire large bowel from the rectosigmoid in 97% of patients (38). It also permits the visualization of the five layers of the colon wall showing the complete characteristics of the tumor (38). The sensitivity in the detection of CRC in the different studies oscillates between 83 and 97% and the specificity is in and around 98% (38-43). Additionally, the precision in the T staging oscillates between 70 and 98% (40,43). In our study, all patients have been studied using the conventional technique and, if we exclude the cases of rectal cancer as they have done in the hydrocolonic sonography studies, the figures of sensitivity and specificity are quite similar while the technique requires less time and is more comfortable for the patient. On the other hand, the conventional technique does not permit an adequate recognition of the T staging. However, the hydrocolonic ultrasound is only precise in the appraisal of the T staging. Other techniques are needed to determine the presence of adenopathies or distant metastases, and thus it is not clear that the value of the hydrocolonic sonography is greatly superior to that of the conventional technique.

Therefore, abdominal sonography represents a specific and very sensitive technique in the detection of colon cancer. It is a simple technique that does not require excessive time for its completion, very well tolerated by the patients and practically risk-free. It should be respected as an alternative to the conventional radiological and endoscopic tests where these techniques are not possible and even in those in which the diagnosis is not clear. The paradigm could be the patients with microcytic anemia and constitutional syndrome, accompanied by non-specific digestive symptoms; in these patients on the list of differential diagnoses the presence of a colon cancer is included, but this list can be quite long. The abdominal sonography as a first diagnostic test may justify carrying out an endoscopic examination and also the choice of the first test to be undergone, since tumors of the gastroduodenal area can also be visualized by the ultrasound. Further well-designed study is needed to confirm the viability of this hypothesis. Nevertheless, highly suspect CRC patients such as those patients over 65 years, with suggestive symptoms and microcytic anemia (the analytic and clinical data which in our patients best predicts the presence of a cancer) a negative ultrasonography should

not exclude endoscopic examination since rectal tumors cannot be detected by means of the ultrasound. But it is possible that in these patients a rectoscopy, less invasive and less costly than a complete colonoscopy, may be sufficient.

Shortly, the abdominal sonography presents high sensitivity and specificity in the diagnosis of tumors located above the rectosigmoid junction. However, the sensitivity in the detection of polypoid lesions of small size is very low, and thus, this technique cannot be proposed for the screening of CRC above all if we keep in mind that the detection and removal of the polyps of the colon has reduced the incidence and mortality rates of colon cancer.

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