

**Aim of the study:** Gastric adenocarcinoma is among most frequent among cancers in Albania. Early detection and staging is helped by imaging methods, including CT and MRI. This study provides evidence on the CT and MRI accuracy in detecting and pre-operative staging of gastric adenocarcinoma in 62 patients in a diagnostic clinic in Albania. The correct staging of the gastric adenocarcinoma helps decide on the next treatment options.

**Material and methods:** Sixty-two patients with gastric adenocarcinoma, confirmed with biopsy, underwent both CT and MRI examination at a clinic in Tirana during same week. Images were reviewed to determine the TNM classifications and staging using the current AJCC guidelines. Data on age, sex, cancer location and differentiation were also collected and analyzed. The accuracy, sensitivity, specificity, positive predictive value and negative predictive value was estimated for both CT and MRI.

**Results and conclusions:** CT has a higher accuracy than MRI (83% vs. 67%) for T1. Accuracy for T2 was the same (74%). Starting with T3 and upwards, MRI has a slightly more accurate ability to detect and stage the gastric adenocarcinoma (T3: 81 vs. 75; T4: 83 vs. 64). Both the CT and MRI abilities to accurately detect the N classification were the same. Regarding the M classification, the MRI has a slightly more accurate ability to detect metastases (M: 83 vs. 64). Clinicians might benefit from using CT whenever suspect gastric adenocarcinoma patients present first. Decision on surgery requires a MRI to rule out metastases.

**Key words:** gastric adenocarcinoma, pre-operative staging, CT, MRI, biopsy.

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# CT/MRI accuracy in detecting and determining preoperative stage of gastric adenocarcinoma in Albania

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## Introduction

Gastric cancer is the second most frequent among cancers [1] diagnosed in Albania, with the majority of cases being classified as gastric adenocarcinomas [2]. The location and the differentiation of the gastric adenocarcinoma varies as do the degrees of disease progress at which patients present when diagnosed. As the gastric cancer is among the main killers, it is vital that patients are examined and the diagnosis is established as early as possible and treatment initiated immediately. Often the treatment options depend on the progress of the disease and the eventual spread either locally or at a distance. Tumor staging and classification often requires a combination of immunohistochemical tests with radiological imaging [3].

Imaging techniques used to detect and pre-operatively stage gastric adenocarcinoma include double contrast barium X-ray, endoscopic ultrasound (EUS), computed tomography (CT), magnetic resonance imaging (MRI), positron emission tomography (PET), somatostatin receptor scintigraphy (SRS) or their variations, depending on the stage of the disease or the sophistication of the clinical settings. In addition to detecting and staging gastric cancer [4–11], these imaging techniques are also useful in detecting other neuroendocrine [12], stromal [3] tumors and lipomas [13].

Previous studies have reported on use of these imaging techniques in exploring involvement of sentinel lymph nodes [14] or spread of gastric adenocarcinoma metastases to the liver [15], peritoneal [16], brain [17], spleen [18], ovaries [19], uterus [20, 21], testicles [21], skeletal muscle [22], or other locations [23–26]. Other studies have highlighted use of these imaging techniques in post-operative evaluation [27, 28] of the disease or recurrences [29].

This article, summarizes the findings of a study, the first of its kind in Albania, looking at the accuracy of CT/MRI in pre-operative staging of the gastric adenocarcinoma, as compared to the golden standard of biopsy. The aim was to identify the most accurate imaging technique by gastric adenocarcinoma stage and make recommendations to clinicians on how to best optimize use of technology for a correct and expedited diagnosis. The determination of the growth (T), local involvement of lymph nodes (N), distant metastases (M) and staging (S) is made using the American Joint Committee on Cancer (AJCC) guidelines [30], version 7.

This study includes CT/MRI findings from 62 patients diagnosed with gastric adenocarcinoma at the Medicare Diagnostic Center (MDC) from January 2013 – January 2014. The study received approval by the MDC Ethical Committee on December 2012.

## Material and methods

Over 350 individuals that were examined for suspected gastric cancer at MDC underwent endoscopy and biopsy between January 2013 and January 2014 in Tirana (Albania). After patient consent forms were signed, free CT

**Table 1.** Study population description (biopsy)

Char.	Total	T				N				M		Stage								
		T1	T2	T3	T4	N0	N1	N2	N3	M0	M1	Ia	Ib	Ila	Ilb	IIla	IIlb	IIlc	IV	
Sex	Female	26	0	4	20	2	9	13	2	2	24	2	0	3	7	10	2	1	1	2
	Male	36	3	4	28	1	12	17	3	4	35	1	2	3	6	17	2	5	0	1
Age	≤ 45	11	0	3	6	2	4	5	0	2	10	1	0	2	3	3	0	1	1	1
	46–65	29	0	5	23	1	11	13	4	1	27	2	0	3	6	13	3	2	0	2
	≥ 66	22	3	0	19	0	6	12	1	3	22	0	2	1	4	11	1	3	0	0
Differ.	Good	27	0	0	24	3	7	12	2	6	25	2	0	0	6	10	2	6	1	2
	Bad	29	2	6	21	0	12	16	1	0	28	1	2	4	6	15	1	0	0	1
	Other	6	1	2	3	0	2	2	2	0	6	0	0	2	1	2	1	0	0	0
Locat.	Distal	32	1	5	25	1	12	15	2	3	31	1	1	4	5	15	2	4	0	1
	Proximal	14	1	1	11	1	5	7	0	2	14	0	0	2	4	6	0	1	1	0
	Infiltrative	16	1	2	12	1	4	8	3	1	14	2	1	0	4	6	2	1	0	2

**Table 2.** CT/MRI findings by characteristic, method of examination and TNM classification

Char.	Total	CT										MRI											
		T				N				M		T					N					M	
		T1	T2	T3	T4	N0	N1	N2	N3	M0	M1	T0	T1	T2	T3	T4	N0	N1	N2	N3	M0	M1	
Sex	Female	26	0	3	21	2	4	17	3	2	24	2	0	0	3	22	1	4	17	3	2	24	2
	Male	36	2	2	30	2	9	19	3	5	34	2	1	1	2	30	2	9	19	3	5	36	0
Age	≥ 45	11	0	2	6	3	2	6	2	1	11	0	0	0	2	8	1	2	6	2	1	10	1
	46-65	29	0	2	26	1	6	18	3	2	26	3	0	0	2	25	2	6	18	3	2	28	1
	≥ 66	22	2	1	19	0	5	12	1	4	21	1	1	1	1	19	0	5	12	1	4	22	0
Differ.	Good	27	0	0	23	4	3	14	3	7	24	3	0	0	0	24	3	3	14	3	7	25	2
	Bad	29	2	4	23	0	9	18	2	0	28	1	1	1	4	23	0	9	18	2	0	29	0
	Other	6	0	1	5	0	1	4	1	0	6	0	0	0	1	5	0	1	4	1	0	6	0
Locat.	Distal	32	1	3	28	0	8	17	3	4	30	2	0	1	3	27	1	8	17	3	4	32	0
	Proximal	14	0	1	12	1	1	12	0	1	13	1	0	0	1	13	0	1	12	0	1	14	0
	Infiltrative	16	1	1	11	3	4	7	3	2	15	1	1	0	1	12	2	4	7	3	2	14	2

and/or MRI examinations were performed in an attempt to determine the spread and stage of the cancer. All patients that were in terminal phase and those that did not undergo both CT and MRI were excluded from the study. Finally, the study population consisted of 62 patients diagnosed with gastric adenocarcinoma, confirmed with biopsy that had undergone both CT and MRI examinations within one week from each other.

MRI examinations were performed using 1.5T Avanto (Siemens Medical Solutions, Erlanghen, Germany) on patients that did not eat 6 hours prior to the examination, using hydro-distention of the stomach. Coronal (TR/TE 900/81, angle 150, matrix 256 × 250, slices 6 mm) and Axial (TR/TE 900/84, angle 150, matrix 256 × 250, slices 8 mm) T2 weighted images were taken. In phase (TR/TE 98/4.2, angle 70, matrix 256 × 205, slices 8 mm) and out of phase (TR/TE 98/2.2, angle 70, matrix 256 × 205, slices 8 mm) T1 weighted images were taken. Axial T2 weighted and fat saturation images (TR/TE 1000/94, angle 150, matrix 256 × 205, slices 6 mm) were also taken. Gradient EKO 3D-VIBE

(Volume Interpolated Breath-hold Exam) axial and coronal (TR/TE 5.58/2.38, angle 10, matrix 320 × 166 slices 3.5 mm) were also taken. Intravenous contrast used was Bayer Magnevist 0.5 mm/ml and/or Bracco Multihance 1 ml/334 mg Gadobenic acid.

Multi-detector CT Emotion-6 (Siemens Medical Solutions, Erlanghen, Germany) was used, with 500 ml oral H<sub>2</sub>O contrast and 100–120 ml i.v. contrast (bolus triggering for arterial phase – and portal phase 60 s after i.v. injection of contrast), in a spiral exam with slices at 5 mm and reconstruction at 1.25 mm. Multi-planar (MPR) and maximum-intensity projection (MIP) reformatting was done for each patient at coronal and sagittal plans. The i.v. contrast used was Bayer Ultravist-300.

Images obtained from CT and MRI were reviewed by a radiology expert and classified based on the growth (T), involvement of lymph nodes (N) or metastases (M) using the AJCC guidelines. Staging was also done using the AJCC guidelines. The data was entered into a database, containing information on the gender, age, location of the ade-

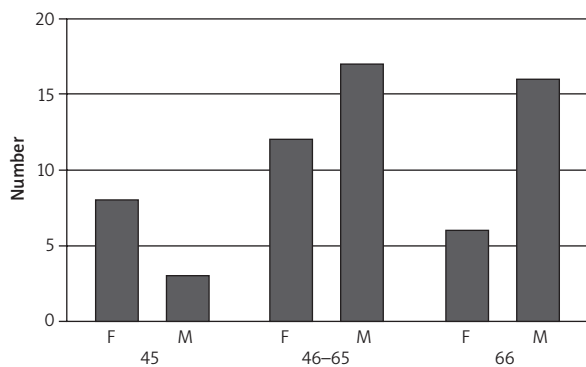


Fig. 1. Cases by sex and age categorized

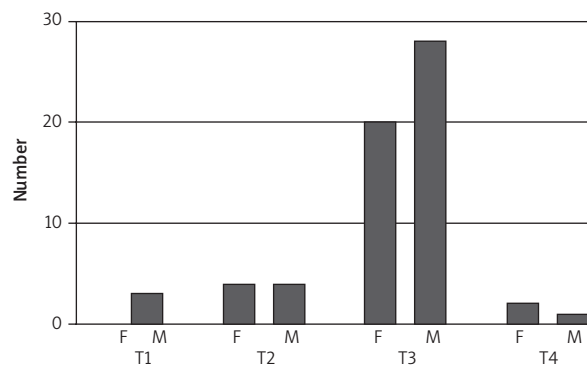


Fig. 2. Cases by biopsy T classification and sex

Table 3. ACC, SN, SP, PPV and NPV by method of examination and TNM classification (in percentage)

Parameter		CT					MRI				
		SN	SP	ACC	PPV	NPV	SN	SP	ACC	PPV	NPV
T	T1	67	100	83	100	98	33	100	67	100	97
	T2	50	98	74	80	93	50	98	74	80	93
	T3	94	57	75	88	73	98	64	81	90	90
	T4	33	95	64	25	97	67	98	83	67	98
N	N0	62	100	81	100	84	62	100	81	100	84
	N1	87	69	78	72	85	87	69	78	72	85
	N2	40	93	67	33	95	40	93	67	33	95
	N3	83	96	90	71	98	83	96	90	71	98
M	M1	33	95	64	25	97	67	100	83	100	98
Stage	I a	100	100	100	100	100	50	100	75	100	98
	I b	33	98	66	67	93	33	98	66	67	93
	II a	54	94	74	70	89	54	94	74	70	89
	II b	74	77	76	71	79	89	77	83	75	90
	III a	50	95	72	40	97	50	95	72	40	97
	III b	83	95	89	63	98	100	98	99	86	100
	III c	0	97	48	0	98	0	98	49	0	98
	IV	33	95	64	25	97	67	100	83	100	98

nocarcinoma and the biopsy findings on differentiation, and TNM classification. In line with AJCC guidelines, the T classification included T0-T4 categories, N0-N3 categories and M0-M1 categories. Staging was classified as IA, IB, IIA, IIB, IIIA-C and IV.

### Statistical analysis

Statistical analysis was performed using Stata for Linux. As the study population consisted of only 62 cases and disaggregation by many categories was required, cases were reported as numbers rather than percentages for most findings, with the exception of the accuracy (ACC), sensitivity (SN), specificity (SP), positive predictive value (PPV) and negative predictive value (NPV). Findings were disaggregated by gender, age category, location of the adenocarcinoma and its differentiation. Accuracy was disaggregated by method of examination and TNM classification.

Binary variables were constructed for each of the T, N and M classifications, and based on their combinations, for the staging of the disease. Two way tables were constructed for study population description and for CT/MRI findings. Three way tables were constructed for displaying the values of ACC, SN, SP, PPV and NPV.

### Results

The 62 biopsy confirmed cases are described in Table 1, showing numbers by characteristic (age, sex, tumor differentiation and location) by biopsy TNM classification and staging.

As shown in Table 1, there were only a few cases in T1 and T4 and most cases were in T3 and less in T2. Only 3 cases had distant metastases and lymph node involvement was spread mostly between N0 and N1. The staging into 8 categories (using AJCC guidelines, version 7, 2010) further complicates the display of the data, with many

cells showing a number of cases less than 5. It was for this reason that Tables 1 and 2 display numbers instead of percentages.

Figure 1 shows the same numbers of cases by sex and age categorized. Figure 2 shows same cases by sex and biopsy T classification. It is clear that the majority of cases present over the age of 45 years old and in men. The biopsy classification by tumor growth shows that most patients present at tumor stage T3 or above, clearly indicating a delay in seeking medical assistance (for the cases in this study).

Table 2 shows the findings from CT and MRI examinations. As far as numbers are considered, aside of small differences in determining the T classification, the N classification is identical. The M classification is also very similar.

Table 3 shows the ACC, SN, SP, PPV and NPV for both examination methods by TNM classification and staging. Despite the small T1 numbers, it looks like the CT has a higher accuracy than MRI (83% vs. 67%). Accuracy for T2 was the same (74%). Starting with T3 and upwards, MRI has a slightly more accurate ability to detect and stage the gastric adenocarcinoma (T3: 81 vs. 75; T4: 83 vs. 64). As mentioned earlier, the CT and MRI ability to accurately detect the N classification was the same. When looking at the M classification, it looks like the MRI has a slightly more accurate ability to detect metastases (M: 83 vs. 64).

After the staging is completed using the AJCC version 7 guidelines, the results on the accuracy show that CT is more accurate in Ia (100 vs. 75). Both methods are equally accurate in Ib, IIa and IIIa (66, 74, 72). MRI appears at a slight advantage when we move to stages IIb (83 vs. 76), IIIb (99 vs. 89), IIIc (49 vs. 48) and IV (83 vs. 64).

What is interesting is that the SN values follow the same trend as the ACC values, with the SP, PPV and NPV being very high and very similar. In practical terms this means that CT would be a preferred method for T1 and MRI for T3-4. Once the examination is positive in either CT or MRI, chances that the patient is confirmed with a positive biopsy finding are equally high. If either CT or MRI exam is negative the patient chances of being free of the disease are very high (as shown in Table 3). MRI is more sensitive and accurate in detecting the metastases of the gastric adenocarcinoma.

## Discussion

An early detection and staging of the gastric adenocarcinoma will guide the next steps on treatment. A correct staging will depend on accurate diagnostic procedures that determine the growth (T), local (N) and distant (M) spread of metastases. Studies published so far have abundant and different evidence when it comes to what diagnostic procedure has the best accuracy, sensitivity and specificity in detecting each element of the TNM classification of the gastric adenocarcinoma.

For example, several studies [31–33] have reported that methods other than CT or MRI are more accurate in determining the T classification. These methods include the use of EUS or endoscopic MRI. Only one study [34] reported that there is no real significant difference between CT

and MRI in correctly detecting the T classification. Several other authors [35–40] concluded that MRI is a more accurate method for determining T. Our findings support those authors [41–43] that concluded that CT is better for early phases of the adenocarcinoma, and MRI for those in later stages.

Our study concluded that there are no differences in the accuracy of detecting the N classification between CT and MRI. This conclusion is the same as what is reported by several authors [39, 42–44]. So far, no other publication that we could identify suggested that CT is more accurate, and only one author [45] suggested that MRI was better for identification of the N classification. Both methods however might be limited when diagnosing lymph node involvement in normal size lymph nodes.

As far as the metastases are concerned, all the studies we reviewed suggest that there is a difference in the ability of the methods to accurately detect distant metastases (M). Two authors [46, 47] concluded that methods other than CT or MRI were better in diagnosing distant metastases. Some studies [48–50] suggested that CT had a higher accuracy in detecting metastases. Our study agrees with those authors [35, 42, 48] that concluded that MRI has a higher accuracy in detecting metastases. One author concluded that while MRI was a good method for detecting hepatic metastases while EUS was more suitable to detect peritoneal metastases.

The results of this study are limited to only CT or MRI findings in staging the gastric adenocarcinoma. Other studies have also looked into other diagnostic methods like double contrast X-ray, EUS or PET. The sample size of patients that were included in the study was small and this might have made it difficult to approximate values to the real life, especially for staging according to 8 categories of the AJCC. Also, we are not sure how do these 62 patients diagnosed with gastric adenocarcinoma change from other patients that did not seek medical assistance to the MDC in Tirana. The majority of patients presented at a late stage of the disease, and we are not sure whether this represent a behavioral trait of the Albanian patients or an inability of primary and secondary level health care facilities to make a timely diagnosis of the gastric adenocarcinoma while still in early stages.

Nonetheless, our study concludes that if patients present early, CT would be the most accurate in detecting T1 or T2. Either CT or MRI can be used to examine close spread of the metastases in the sentinel lymph nodes, while advanced stage T3 or T4 and distant spread of metastases are best detected with MRI. A comparison with other methods like EUS might be warranted to contrast with CT for early stages. A comparison of PET with MRI might be valuable for comparing the accuracy in detection of late stage and distant metastases.

The implication for the Albanian clinicians is that primary and secondary levels might benefit from making use of the CT whenever suspect gastric adenocarcinoma patients present and other methods are not available (like endoscopy or EUS). Final decision on surgery will require a MRI examination to detect or rule out distant spread of the disease.

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