Journal of American Science

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Multidisciplinary Academic Journal Publisher

Can Endoscopic Guided Elastography Improve Nodal Staging of Gastrointestinal Malignancies?

Nancy Abdalla Atta[1], Hussein Okasha[2], Ahmed Ali Goma[1], Samy Zaky[3], Essam Ali Hassan[1].

[1]Department of Tropical Medicine, Faculty of Medicine, Fayoum University, Fayoum, Egypt.
[2]Department of Internal Medicine, Faculty of Medicine Kaser El-Eni Cairo University, Cairo, Egypt.
[3]Department of Heoatogastroentrology, Faculty of Medicine, Al-Azhar University, Cairo, Egypt
Naa08@fayoum.edu.eg, Okasha_hussein@hotmail.com, Afifi1968@yahoo.com, SamyZs55@azhar.edu.eg, Essam_tropical@yahoo.com

Abstract: Elastography adds valuable information to EUS by providing a qualitative and quantitative evaluation of tissue stiffness, thus reflecting the malignant or benign nature of the disease. Aim of work: In this study we aimed to assess whether endosonographic elastography is able to improve LN staging in patients with gastrointestinal malignancies. Results: Strain Ratio in our study showed promising results in prediction of malignant LNs, with sensitivity & specificity; 95.5% & 66.7% respectively at cut off level of >2.57. As regards elastography score, there is statistically significant difference with p-value <0.05 between benign and metastatic lymph nodes with high percentage of score 2 among benign group and high percentage of score 3 among malignant patients. In our study we can change plan of management in 36% of our patients. Conclusion: Elastography can provide additional information about the structure and pathology of abdominal LNs. Whereas, the differential diagnosis of malignant and benign LNs cannot be solved for certain, it seems to be an excellent method for targeting different areas of the LN to avoid unnecessary needle passes in EUS-FNA.

[Nancy Abdalla Atta, Hussein Okasha, Ahmed Ali Goma, Samy Zaky, Essam Ali Hassan. **Can Endoscopic Guided Elastography Improve Nodal Staging of Gastrointestinal Malignancies?** *J Am Sci 2021;17(9):71-82]. ISSN 1545-1003 (print); ISSN 2375-7264 (online). http://www.jofamericanscience.org* 8. doi: 10.7537/marsjas170921.08.

Key words: Elastography, endoscopic ultrasound, endoscopic-ultrasound elastography, lymph node, Gastrointestinal malignancies.

1. Introduction

Ultrasound (US), as a widely available imaging technique, has proved its value in diverse clinical applications and many studies and reviews have been published over the years, including its role in the assessment of rare gastrointestinal (GI) diseases or hardly accessible organs [5].

One of the best diagnostic tools to assess the digestive tract and surrounding organs is endoscopic ultrasound (EUS), but one of its major limitations is the limited capacity to determine the exact nature of a lesion [10]. Differential diagnosis between benign and malignant lymph nodes (LNs) based on the EUS appearance is difficult and frequently requires EUS-guided fine needle aspiration biopsy (EUS-FNAB) for confirmation of malignancy [13].

The European Society of Gastrointestinal Endoscopy (ESGE) published recommendations on EUS-guided sampling made for various settings, including LNs [9].

Although the specificity of EUS-FNAB is close to 100%, **[1]** it potentially misses microinvasion of malignancy into LNs. Also, it requires experience and it is associated with a risk of complications which, even if it is low, is not negligible [8].

According to the guidelines of the ESGE published by **Dumonceau *et al*., 2011** [6] contrast-enhanced EUS and EUS-elastography are new techniques developed to increase the negative predictive value (NPV) of EUS-FNAB. Many researches and detailed technical explanations published indicate that these techniques may potentially be useful to select diagnostically significant LNs and also the most suspicious area of a LN to be targeted for FNAB [4].

As a noninvasive technique, EUS elastography complements conventional EUS with minimal prolongation of the examination time, minimum cost, and no added complication or death [11].

Till now, EUS-elastography imaging has been proved to offer complementary information added to conventional EUS imaging, representing a promising method that allows the differential diagnosis of benign and malignant LNs [3].

It is easy to be included in clinical staging and, particularly with computer-aided pixel analysis, significantly improves the specificity of LN staging. The most significant advantage of EUS-elastography is that it can be performed in real-time during a diagnostic examination and can immediately give

important information that can impact patient management [2].

Aim of work

The aims of the present study are to assess whether endosonographic elastography is able to improve LN staging in patients with gastrointestinal cancer.

2. Patients and Methods

Study design and population:

It is a cross sectional prospective study conducted upon 50 patients with known gastrointestinal, pancreatic or ampullary malignancy and suspicious lymph node (LN) during endosonographic examination (EUS) who referred to EUS unit, in whom EUS-guided fine needle aspiration (FNA) is planned for staging and EUS elastography was done for them.

FNA was performed in all cases as a gold standard, targeting one or more suspicious LN per patient.

Inclusion criteria:

1- Patient with GIT cancer diagnosed by endoscopy and confirmed by histopathological examination.
2- Presence of suspicious LN on EUS examination.
3-LN will be suspicious if it has two or more of the following criteria:

Exclusion criteria:

1- Presence of constricting mass that prevents endoscopy from progressing forward.
2- Absence of suspicious LN.

- All cases were subjected to:

• Careful history taking stressing on age, sex, occupation, history of abdominal pain, anorexia, weight loss, vomiting , diarrhea , constipation , hematemesis or melena.
• Full general examination to detect signs of weight loss or prescience of lymphadenopathy.
• Local abdominal examination to detect any abdominal tenderness or masses.
• Routine laboratory investigations including (CBC, ESR, liver function tests and kidney function tests).
• CA 19-9
• Imaging whether ultrasound, CT or MRI.
• Endoscopic Ultrasound examination using a Pentax linear array EUS machine type EG-3870-UTK connected to Hitachi Avius Machine with incorporated soft ware for assessment of suspicious LN elasticity by real time Elastography and strain ratio.

Methodology in details:

In all patients EUS was done upon request of their consulting physicians, an informed consent was taken after explaining the procedure to the patient. For confidentiality, their names were omitted and replaced by numerical codes. Patients on the day of the procedure were subjected to the following:-

- Thorough history taking and clinical examination.
- All the patients' data were recorded.
- For patients were EUS was done; EUS linear array machine was used (Pentax EG-3870-UTK Echo-endoscope, HOYA Corporation, PENTAX Lifecare Division, Showanomori Technology Center, Tokyo, Japan) connected to an ultrasound unit Hitachi EUB-7000, Hitachi Medical System, Tokyo, Japan).
- For either patients, target lymph nodes were initially identified and their detailed sonographic features were assessed including size, longest diameter, shortest diameter and the ratio of shortest/longest diameter, echotexture (echogenic or echopoor) and its hilum (lost or preserved).
- Elastography was then displayed with the B-mode image in a color scale that ranged from red for components with greatest elastic strain (i.e. softest components) to blue for those with no strain (i.e. hardest components). Elastography scoring patterns used were:-

Pattern 1: >80%of the cross-sectional area was red or green i.e. soft.
Pattern 2: >50% and <80% was red or green.
Pattern 3: >50% and <80% was blue.
Pattern 4: > 80% of the cross-sectional area was blue i.e. hard [7]

Strain Ratio (SR) was calculated as B/A ; where R_2 represented the elastography of a selected soft (red) reference area outside the target lymph nodes, preferably the gut wall, perinodal tissue or subcutaneous tissue, while R1 represented the elastography of the targeted lymph nodes as shown in Figure (1).

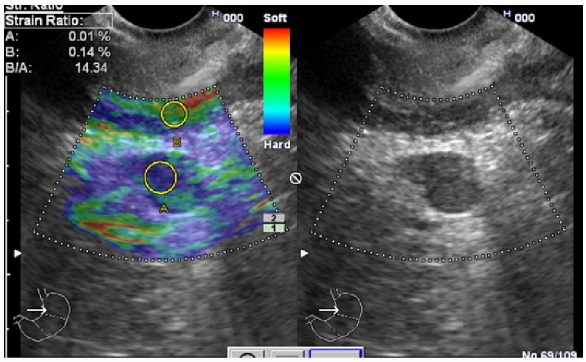

Figure (1) Elastography of malignant peripancreatic LN.

Study definitions

- EUS diagnosis suggestive of malignant or benign lymphadenopathy depended on the presence of > 2 features of:

-Echogenicity (echo poor for malignancy and echogenic for benign LNs).
-Transverse/longitudinal diameter ratio (>0.5 for malignant and <0.5 for benign LNs).
-Loss of hyperechoic hilum for malignancy and preserved hilum for benignLNs [12].

- Lesions that presented with elastography pattern 1 or 2 were classified as probably benign, while pattern 3 and 4 are indicative of probable malignancy

Final gold standard diagnosis was made by FNA, cytopathological examination and immune-histochemistry if needed or excision surgical biopsies during resection or surgical exploration. Benign lymph nodes were followed-up by sonography or CT scanning for at least 6 months to be sure that they are not increasing in size ensuring their benign nature.

Compliance with the study:

All patients were compliant with the study.

Consent of the patients: The protocol was approved by the ethical committee and an informed consent was obtained.

Statistical Analysis

The statistical analysis was done using SPSS 13.0 (SPSS Inc., Chicago) software. The categorical variables were expressed by their absolute (n) and relative frequency (%) and compared using the Chi-squared test or Fisher Exact test. The continuous variables were expressed by mean and standard deviation and compared by using Student's *t*-test or Mann-Whitney *U* test. An association was considered to be statistically significant at $P < 0.05$. Stepwise logistic regression analysis was carried out to search for independent predictors of malignancy. The sensitivity, specificity, positive (PPV) and negative predictive values (NPV), with 95% confidence intervals (95% CI), and overall accuracy were calculated.

Data were analyzed by sensitivity and specificity derived from the receiver operating characteristic (ROC) curve and area under the ROC curve (AUC). The McNemar test was used to compare these calculated sensitivities and specificities.

Ethical Considerations

This study was reviewed and approved by the ethics review board of the Fayoum University, Faculty of medicine. All of the patients gave informed consent before they participated in the study. The official approval was obtained from the general director of the hospital, manager of outpatient clinic and the head of Tropical Medicine department.

3. Results

Patients:

It is a cross sectional prospective study conducted upon 50 patients with known gastrointestinal, pancreatic or ampullary malignancy and suspicious lymph node (LN) during endosonographic examination (EUS) who referred to EUS unit, in whom EUS-guided fine needle aspiration (FNA) is planned for staging and EUS elastography was done for them.

FNA was performed in all cases as a gold standard, targeting one or more suspicious LN per patient.

Table (1) illustrates that the mean age of study group was (56.6 ±8.8) years old ranged between (40 and 78) years, 66% of them were males and 34% were males.

Table (1): Description of demographic characters among study group.

Variables	Number (n=50)	
Age (years		
Mean /SD	56.6	8.8
Sex		
Male	33	66%
Female	17	34%

Frequency of primary lesions among study group

Table (2) illustrates that 48% of study group presented by pancreatic adenocarcinoma as a primary lesion, followed by 24% had Gastric adenocarcinoma, 10% had papillary adenocarcinoma, 6% had HCC, also 4% represented by Rectal adenocarcinoma, 4% had Klatskin tumor, finally 2% show Gall bladder adenocarcinoma and Squamous esophageal.

Table (2): Frequency of primary lesions among study group.

Primary lesions	Number (n=50)	%
Pancreatic adenocarcinoma	24	48%
Gastric adenocarcinoma	12	24%
Papillary adenocarcinoma	5	10%
HCC	3	6%
Rectal adenocarcinoma	2	4%
Klatskin	2	4%
Gall bladder adenocarcinoma	1	2%
Squamous esophageal	1	2%

Frequency of different symptoms among study group.

Frequency of different symptoms among study group was 52% of cases complained Obstructive jaundice, followed by 38% complained by epigastric pain, 22% had weight loss, 10% had anemia, 6% complained HFL, and finally 2% complained dysphagia(Table 3).

Table (3): Frequency of different symptoms among study group.

Symptoms	Number (n=50)	%
Obstructive jaundice	26	52%
Epigastric pain	19	38%
Weight loss	11	22%
Anemia	5	10%
HFL	3	6%
Bleeding per-rectum	2	4%
Dysphagia	1	2%

Frequency of lymph node distribution among study group.

Frequency of lymph node distribution among study group was 36% had peripancriatic lymph node, and 26% had celiac lymph node, 24% had porta-hepatic lymph node, and 4% had Aortocaval, and Perigastric, and Pararectal, finally 2% had Para-esophageal (Table 4).

Table (4): Frequency of lymph node distribution among study group.

Variables	Number (n=50)	%
Lymph node group		
Peripancreatic	18	36%
Celiac	13	26%
Porta-hepatis	12	24%
Aorto-caval	2	4%
Perigastric	2	4%
Pararectal	2	4%
Para-esophageal	1	2%

Frequency of sonographic criteria of lymph nodes among study group.

The ultrasonographic features of the lymph nodes regarding shape of the lymph node, echogenicity and hyperechoic hilum preservation. Table (5) illustrates that 94% of cases were globular in shape (shortest /longest diameter >0.5) versus 6% were elongated (shortest /longest diameter <0.5), as regards echogenicity of the lymph node 82% were echo-poor but 18% were echogenic. As regards the hyperechoic hilum of the lymph node 84% of them were lost and 16% were preserved.

Description of lesion size among study group

Table (6) illustrates that the mean Shortest/longest ratio of lesion size was (0.74 ±0.16) ranged between (0.37 and 1)

As regard lesion shortest diameter the mean was (16.2±8.7) mm, ranged between 5 and 55 mm.

Table (5): Frequency of sonographic criteria of lymph nodes among study group.

Variables	Number (n=50)	%
Lymph node shape		
Globular	47	94%
elongated	3	6%
Echogenicity		
Echo-poor	41	82%
Echogenic	9	18%
Hilum of the lymph node		
Lost	42	84%
Preserved	8	16%

Table (6): Description of lesion size among study group.

Variables	Minimum	Maximum	Mean	SD
Shortest/longest ratio	0.37	1	0.74	0.16
Shortest diameter(mm)	5	55	16.2	8.7

Sonographic criteria of benign and malignant lymph nodes

Table (7) illustrates that there is statistically significance difference with p-value <0.05 between benign and malignant lymph nodes as diagnosed by histopathological examination as regards echogenicity and loss of hyperechoic hilum with high percentage of echo-poor lesion and hilum loss were found among metastatic lymph nodes and high percentage of echogenic lesion and preserved hilum among benign lymph nodes. On the other hand there is no statistical significance difference with p-value >0.05 as regards shape and Shortest/longest ratio of lymph nodes.

Table (7): sonographic criteria of benign and malignant lymph nodes

Variables	Malignant (n=43)		Benign (n=7)		p-value	Sig.
	No.	%	No.	%		
Shortest/longest ratio						
<0.5	1	2.3%	0	0%	0.9	NS
≥ 0.5	42	97.7%	7	100%		
Lesion shape						
Globular	41	95.3%	6	85.7%	0.4	NS
Elongated	2	4.7%	1	14.3%		
Echogenicity						
Echo-poor	38	**88.4%**	3	42.9%	**0.01**	**S**
Echogenic	5	11.6%	4	**57.1%**		
Hilum loss						
Lost hilum	42	84%	8	16%	0.01	S

Description of strain ratio (SR) among studed lymph nodes

Table (8) illustrates that the mean strain ratio (SR) was (21.5 ±26.4) ranged between (0.37 and 114)

Table (8): Description of strain ratio (SR) among studed lymph nodes.

Parameter	Strain ratio (SR)
Minimum	0.37
Maximum	114
Mean	21.5
SD	26.4
SE	3.7

Description of elastographic score among study group

Table (9) illustrates that 20% of cases had benign lymph nodes by elastographic score (18% of them with score 2 and 2% with score 1), 80% of cases had malignant lymph nodes (52% with score 3, and 28% had score 4).

Table (9): Description of elastographic score among study group.

Elastography score	Number (n=50)	%
Benign		
Score 1	1	2%
Score 2	9	18%
Malignant		
Score 3	26	52%
Score 4	14	28%

Frequency of different methods of lymph node diagnosis among study group

Table (10) illustrates that 86% of cases had metastatic lymph nodes when diagnosed by sonographic criteria by EUS versus 88% when diagnosed by EUS elastography and by fine needle aspiration the percentage was 86%.

Table (10): Frequency of different methods of lymph node diagnosis among study group.

Variables	Number (n=50)	%
Sono-graphic diagnosis		
Malignant	43	86%
Benign	7	14%
elastographic diagnosis		
Malignant	44	88%
Benign	6	12%
Fine needle aspiration diagnosis		
Malignant	43	86%
Benign	7	14%

Comparisons of elastografic score benign and metastatic lymph nodes.

As regards benign lymph nodes percentage of patients was 14% diagnosed by sonograph, versus 12% when diagnosed by clinical finding and by fine needle aspiration the percentage was 14%.

Sensitivity and specificity of Strain ratio (SR), sonographic criteria of lymph node and elastography final diagnosis in diagnosis of metastatic lymph nodes

Table (11) illustrates that there is statistically significant difference with p-value <0.05 between benign and metastatic lymph nodes as regards elastography score with high percentage of score 2 among benign group and high percentage of score 3 among malignant patients.

Table (11): Comparisons of elastografic score benign and metastatic lymph nodes.

Variables	Malignant (n=43)		Benign (n=7)		p-value	Sig.
Elastography score						
Score 1	1	2.3%	0	0%	**0.04**	**S**
Score 2	6	14%	**4**	**57.1%**		
Score 3	**24**	**55.8%**	1	14.3%		
Score 4	12	27.9%	2	28.6%		

Table (12) showed that the sensitivity and specificity for strain ratio in comparison with final diagnosis illustrates the probability of being true positive is (**73.04%**) more than being false positive when repeat test 100 times with sensitivity (**95.5%**) and specificity (**66.7%**) at cutoff value of (**2.57**).

- Sensitivity and specificity test for sonographic criteria (echogenicity and preserved echogenic hilum) of the lymph nodes in comparison with final diagnosis illustrates the probability of being true positive is (**72.5%**) more than being false positive when repeat test 100 times with sensitivity (**93.2%**) and specificity (**66.7%**) figure (2) , (3).
- Sensitivity and specificity test for elastography score in comparison with final diagnosis illustrates the probability of being true positive is (**71.03%**) more than being false positive when repeat test 100 times with sensitivity (**86.4%**) and specificity (**66.7%**). scores 1 and 2 were considered benign while scores 3 and 4 were considered malignant Figure (4).

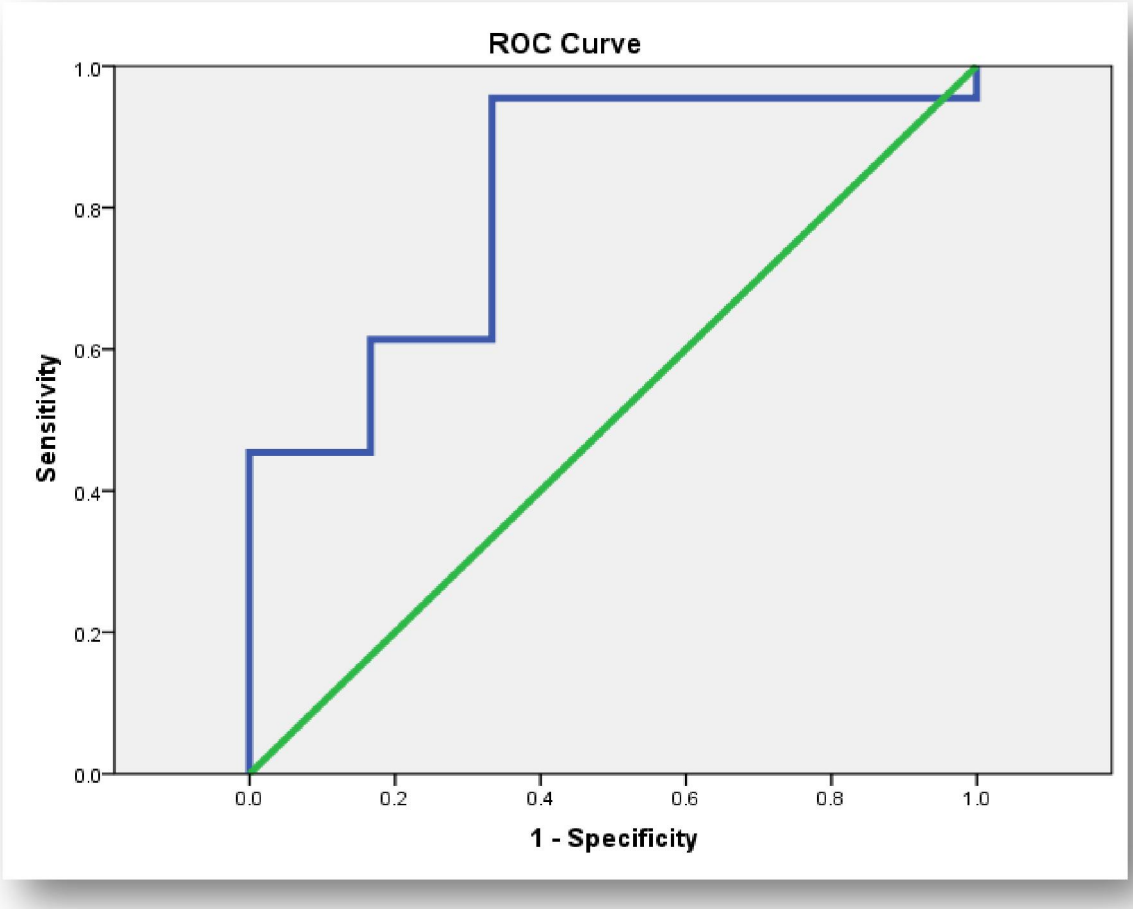

Figure 2: ROC curve for Strain ratio (SR)

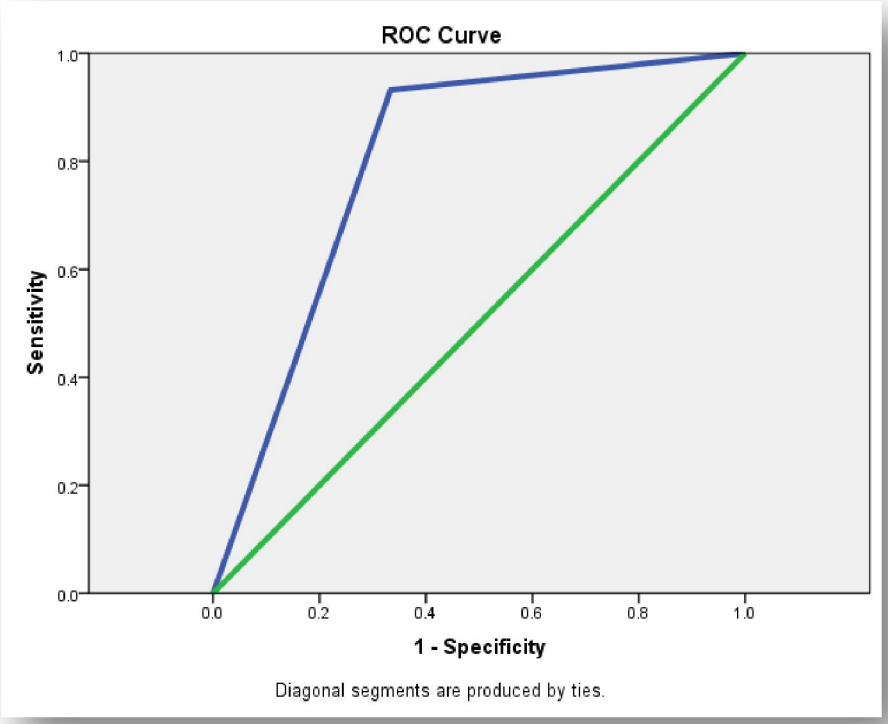

Figure 3: RC

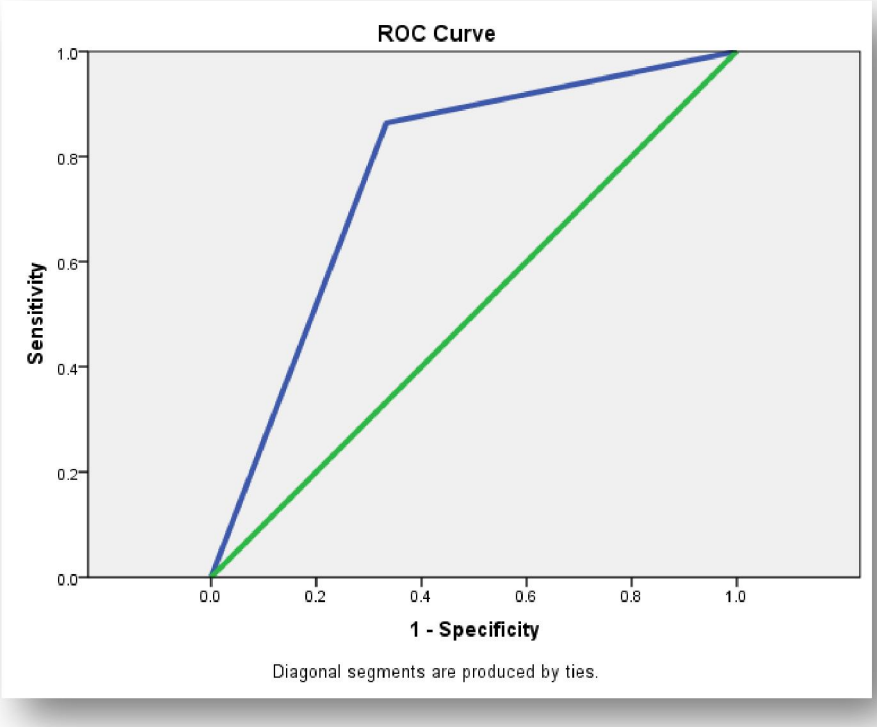

Figure 4: ROC curve for Elastography score

Patients whose plane of management changed by EUS elastography

Table(13) illustrates that we changed the plan of management in 36% of cases, 8% had cancer of pancreatic head , 18% had gastric adenocarcinoma, and 4% had rectal adenocarcinoma and also same percentage for hepatocellular carcinoma finally only 2% had esophageal carcinoma.

We change plan of management in 18 patients (36%) out of 50 patients referred for nodal staging by EUS elastography.

Table (12): Sensitivity and specificity of Strain ratio (SR) , sonographic criteria of lymph node and elastography final diagnosis in diagnosis of metastatic lymph nodes.

Variable	Sensitivity	Specificity	AUC	Accuracy	Cut off point
Strain ratio (SR)	95.5%	66.7%	81.4%	73.04%	2.57
Sonographic criteria (Echognicity and preserved echognic hilum)	93.2%	66.7%	79.9%	72.5%	--------
Elastography score	86.4%	66.7%	76.5%	71.03%	--------

AUC: Area under the curve SR: Strain ratio

Table (13): Patients whose plane of management changed by EUS elastography.

Primary lesions	Number (n=50)	Number of cases changed plane of management	%
Total number	50	18	36%
Pancreatic adenocarcinoma	24	4	8%
Gastric adenocarcinoma	12	9	18%
Papillary adenocarcinoma	5	-	-
HCC	3	2	4%
Rectal adenocarcinoma	2	2	4%
Klatskin	2	-	-
Gall bladder adenocarcinoma	1	-	-
Squamous esophageal	1	1	2%

Out of 24 patients with pancreatic adenocarcinoma referred for EUS for nodal staging (4 patients with pancreatic adenocarcinoma of body and 20 patients with cancer head of pancreas), 12 patients of them had primary station LNs (peripancreatic LNs) which doesn't influence decision of surgical intervention, 8 patients had 2nd and 3rd station LNs (para-aortic, portahepatis and aorto-caval LN), 4 of them suggested by EUS-E and confirmed by FNA to be metastatic, so they became inoperable and LNs proved to be benign ones in 4 patients there, so decision of surgical intervention was suitable for them with no change in the plan of management.

We have 15 patients with esophageal, gastric and rectal malignancies referred for nodal staging by EUS. EUS-E was done and its results were confirmed by FNA. We found that 3 patients have benign LN and 12 patients have metastatic LNs and according to guidelines any N stage need neoadjuvant chemotherapy to downstage the tumor before surgical intervention. So the plan of management of these 12 patients was changed and they received neoadjuvant chemotherapy before surgery.

Also out of 3 patients with hepatocellular carcinoma 2 of them (HCC) by EUS examination proved to have metastatic LNs at portahepatis so they became not fit for curative resection, RF or microwave ablation or palliative (TACE) therapy, their plan of management was only supportive treatment.

We have 5 patients with papillary adenocarcinoma one of them had benign LN and the other 4 were 1st station LN so decision of treatment didn't changed.

There was 2 patients with klatskin tumor, one of them proved to have benign LN by FNA, the other patient had metastatic LN at 1st station group of LNs (portahepatis) so plan of management didn't changed.

Also we have one patient with cancer gall bladder have malignant LN at 1st station (portahepatis) and so decision of management didn't changed.

4. Discussion

An accurate staging is necessary to select the best treatment and evaluate prognosis in oncology.

Staging usually begins with noninvasive imaging such as computed tomography, magnetic resonance imaging or positron emission tomography.

In the absence of distant metastases, endoscopic ultrasound plays an important role in the diagnosis and staging of gastrointestinal tumors, being the most accurate modality for loco-regional staging. Its use for tumor and nodal involvement in pre-surgical evaluation has proven to reduce unnecessary surgeries [16].

Our study was conducted on 50 patients with mean age 56 years and 66% were male. They have different types of gastrointestinal malignancies, 48% have pancreatic adenocarcinoma, 18% have gastric adenocarcinoma, 10% have papillary adenocarcinoma, 6% have gastric lymphoma, 6% have hepatocellular carcinoma and small percents have rectal adenocarcinoma, Klatskin tumor, Gall bladder adenocarcinoma and esophageal cancer.

The presenting symptoms were variable but 52% were presented with obstructive jaundice, 38% with epigastric pain, 22% with weight loss and other symptoms as anemia, bleeding per rectum and dysphagia.

There were different lymph node groups detected by EUS in our patients, 36% were pripancreatic group, 26% celiac, 24% porta-hepatis, 4% aorto-caval, 4% perigastric, 4% para-rectal and 2% para-esophageal group of lymph nodes.

In our study we found that hypoechogenisity and lost hilum of lymph nodes were good predictors of metastatic LN, we found 88,4% of malignant LNs are hypoechoic, 11.6% were echogenic while 57.1% of benign LNs were hyperechoic. This agrees with study by **Okash *et al* 2014** conducted on 88 patient who underwent EUS or US examination of different groups of lymph nodes (LNs) and found that 98.3% of the benign LNs were hyperechoic, 1.7% was hypoechoic while 89.7% of the malignant LNs were hypoechoic, 3.4% were heterogenous and 6.9% were hyperechoic [17].

However, we couldn't found significant difference in shape of lymph node and shortest/ longest diameter between benign and metastatic lymph nodes which agree with **Ahuja *et al*., 1995 who study** sonographic criteria of 33 patients with proven tuberculous cervical adenitis and 32 patients with proven metastatic nasopharyngeal carcinoma and found that the size, shape and internal architecture of the nodes, previously described criteria in differentiating benign from malignant nodes, did not help [1].

Also, this agree with **Byung *et al*., 2014** who report that hypo echogenicity and absence of lymph node hilum remained significant in a multivariate analysis. However our study differs in that shape and the shortest diameter was not statistically significant [5]**.**

Strain Ratio in our study showed promising results in prediction of malignant LNs, with sensitivity & specificity; 95.5% & 66.7% respectively at cut off level of >2.57, AUC 81.4% with probability of being true positive (Accuracy) is **(73.04%)** more than being false positive when repeat test 100 times. It also had a very powerful correlation with final diagnosis; SR was significantly higher in malignant lymph nodes with p-value < 0.0001.

In a study conducted by **Okasha *et al*., 2018** on 126 Egyptian patients with lymphadenopathy they found SR with cut off value 4.61 has a sensitivity and specificity of 89.8% and 83.3%, respectively [18].

Paterson et al assessed the role of strain ratio in the nodal staging of esophageal and gastric tumors using fine needle aspiration cytology as the reference standard. There were 53 examined LNs, with a strain ratio cut-off value of ≥7.5 for malignancy; sensitivity, specificity, PPV, NPV, and accuracy were 83%, 96%, 95%, 86%, and 90%, respectively, as compared to the values of 22-70%, 64-96%, 61-83%, 57-72%, and 60-75%, respectively, obtained for different B-mode EUS criteria [19].

Larsen *et al*., evaluated the use of EUS, EUS-elastography, SR, and EUS-FNA in the assessment of LNs of upper gastrointestinal tumors, using surgical pathology as a reference. A total number of 56 LNs were examined. The sensitivity, specificity, accuracy, PPV, and NPV are of 55%, 85%, 73%, 71%, and 74%, respectively for EUS-elastography; 59%, 82%, 73%, 68%, and 76%, respectively, for SR calculation at a cut-off value 4.5, the sensitivity and specificity of EUS-FNA were 64%, 96% respectively [15].

Our study result very close to study by **Knabe *et al.*** that aimed to assess whether EUS-elastography was able to improve LN staging in patients with esophageal cancer. A total number of 40 patients with known esophageal cancer were prospectively enrolled. Using histological/cytological results, out of the 40 LNs examined, 21 were proved to be malignant. The proportions of color pixels were assessed using computer analysis of the elastography images. Sensitivity, specificity, and PPVs of EUS-elastography alone were of 100%, 64.1%, and 75%, respectively, as compared to the values of 91.3%, 64.7%, and 74%, respectively, obtained for B-mode criteria [14].

As regards elastography score, there is statistically significant difference with p-value <0.05

between benign and metastatic lymph nodes with high percentage of score 2 among benign group and high percentage of score 3 among malignant patients. Sensitivity, specificity, PPV and AUC were (86.4%) , (66.7%), (71.03%) and 76.5% respectively.

Rubaltelli *et al*, In the study of cervical lymph nodes found that elasticity score had sensitivity 75%, specificity 80%, accuracy 77%, PPV 80%, NPV 70% [22].

Ghajarzadeh *et al*, in a study conducted on 578 individuals with a total number of 936 cervical LNs was evaluated for the differentiation of benign and malignant LNs found that E-score has Sensitivity, specificity and AUC were 84%, 80% and 86% respectively [10].

In our study we can change plan of management in 36% of our patients in 4 patients with cancer head of pancreas whose 2nd station LN proved to be benign LN so they became operable 'Whipple operation', 12 patients with gastric, esophageal and rectal cancers who proved to have metastatic LNs at 2nd and 3rd station LNs and they needed neoadjvent chemotherapy for down staging before operation and 2 patients with HCC who received just supportive treatment instead of RF or TACE due to metastatic LNs at portahepatis. While 8 patients with papillary adenocarcinoma, kaltskin tumor and gall bladder tumor there LN were either benign or at 1st station group of lymph nodes so decision of treatment didn't changed in them.

In a study by **Hassan *et al***., in 234 patients with gastric cancer, EUS detected 99 lesions suspicious to be distant metastases, among them 85 were suspicious LNs, mostly located in the mediastinum. EUS-FNAB confirmed distant LN metastases in 58% of targeted LNs and changed the management in 34 of the 234 patients (15%) undergoing EUS for staging, avoiding unnecessary surgery [12].

Also in a study by ***Araujo et al, 2013****, the* Decisions concerning treatment were modified in 52.9% of patients by distant LN EUS-FNA results at the first pre-operative EUS staging [2].

Giovannini *et al* retrospectively evaluated the EUS-FNA impact in patients with esophageal cancer, in which a positive cytology result of distant LNs changed therapeutic approach. In this study, EUS-FNA changed the clinical management in 60% of patients [11].

Conclusion and Summary

As a minimally invasive method, EUS plays an important role in assessing malignancies of the GI tract and nearby organs. Elastography adds valuable information to EUS by providing a qualitative and quantitative evaluation of tissue stiffness, thus reflecting the malignant or benign nature of the disease.

Elastography can provide additional information about the structure and pathology of abdominal LNs. Whereas, the differential diagnosis of malignant and benign LNs cannot be solved for certain, it seems to be an excellent method for targeting different areas of the LN to avoid unnecessary needle passes in EUS-FNAC.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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