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The Utility of 2D US to Identify Lower Esophageal Diseases Correlated with Upper GI Endoscopy

Abd Elrazek Abd Elrazek[1,*], *Abdallah Nawara*[2], *Ali Ismael*[2], *Elsayed A. Elgohary*[2] *and Mohammad M. Sallam*[2].

[1] Department of Gastroenterology and Hepatology, Aswan Faculty of Medicine, Aswan University, Egypt.
[2] Department of Internal medicine, Zagazig faculty of medicine, Zagazig University, Egypt.

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Abstract: Background and Aim: Esophageal diseases are important medical concerns in developed and developing countries, where neoplasms and esophageal varices are common, respectively. The ability to observe the intra-abdominal portion of the esophagus with two dimensional Ultrasonography has been recognized. Given the cost and invasive nature of endoscopic screening, there is an interest in the development of non-invasive predictors for the presence and development of such esophageal diseases. Patients and Methods: The intra-abdominal portion of the esophagus was examined using 2D US for (200) patients, divided into a hepatic group; (100) patients, and a non-hepatic group; another (100) patients, presented with manifestations of liver diseases and gastrointestinal symptoms, respectively. Correlation between intra-abdominal esophageal wall thicknesses observed using standard 2D ultrasound and esophageal diseases detected by EGD was applied. (100) normal individuals taken as a control group. Results: The mean thicknesses of the esophageal walls were (3.7 ± 0.5) mm, in normal individuals, however Esophageal wall thicknesses ≥ 4.3 mm should correlated with esophageal diseases, confirmed by EGD. The overall accuracy of 2D ultrasound was 88.9%. Conclusion: There is evident direct correlation between intra-abdominal esophageal wall thicknesses observed using 2D Ultrasound and esophageal diseases seen by EGD. Two-dimensional ultrasound can play an important role in screening esophageal diseases.

Keywords: Ultrasound, Esophagus, Liver cirrhosis, Upper GI Endoscopy, Esophageal neoplasm.

Abbreviations: EGD: Esophagogastroduodenoscopy; GERD; Gastro-Esophageal Reflux Disease; 2D US: Two-dimensional Ultrasound.

1 Introduction

On January 2014, The American Journal of The Medical Sciences *(AJMS*), the official Journal of the Southern Society for Clinical Investigation (SSCI), Texas; USA, published a manuscript entitled "Detection of risky esophageal varices by two-dimensional ultrasound; when to perform Endoscopy [1], shed light on the beneficial using of Two-dimensional US, can play an important role in screening for esophageal varices, furthermore *UpTodate*© evidence based- website cited the manuscript as a useful non-invasive tool in predicting esophageal varices in those presented with liver cirrhosis [2].

Additionally, authors recommended the esophagus should be screened during routine conventional abdominal US. Following the recommendations of the mentioned study to detect/ follow many esophageal lesions in addition to esophageal varices, to refer patients with suspected lower esophageal lesions directly to Gastrointestinal Endoscopy unit to confirm diagnosis and treat adequately and rapidly. Here we will report a study showing the importance of conventional 2D US to predict diagnosis of such esophageal lesions, would be helpful for early diagnosis and management adequately.

2 Patients and Methods

This prospective study was conducted at Al Azhar university hospitals and Aswan university hospital, Egypt, in the period from October 2014 to April 2016.

Two hundred patients; (140) Male and (60) Female were included in the current study divided into two groups; (Hepatic); 100 patients and (GI) group; another (100) patients; (70) Male and (30) Female for each group, aged (18 to 66) years old.

Another (100) healthy individuals were selected as a control group (60) Males and (40) females.

A written informed consent was obtained from each patient.

3 Sonography Technique

We advised each patient to fast at least 6 to 8 hours before sonographic examination. Charcoal (280 mg) when administered 8 hours before the procedure might be beneficial in obese patients and in those with colonic gaseous distension.

*Corresponding author e-mail: ahmadrazek@gmail.com

Two-dimensional ultrasound (2D US) was used to measure the thickness of anterior and posterior walls of intra – abdominal portion of the esophagus by applying a convex 2D US probe at the midline (epigastric region). Asking the patient to take shallow respiration during the technique, to examine the intra – abdominal portion of esophagus would be helpful to demonstrate accurate measurement

The probe is applied gently on the epigastric region, taking the left lobe of the liver as an acoustic window, so we can detect the intra-abdominal portion of the esophagus just anterior to the abdominal aorta. Intra- abdominal esophagus was identified as a curving tubular structure with inner hyperechoic and outer hypoechoic walls (Figure 1). Inner wall irregularities is a sign of esophageal abnormalities with increasing wall thickness to diagnose varices, neoplasms, Barrett esophagus and lower esophageal infiltrating lesions.

For prediction diagnosis of achalasia or sliding hiatus hernia, we have to perform flush test as follow:

1- Ask the patient to drink a glass of water, hold the water, never swallow unless you asking him/her to swallow.

2- Normally after water swallowing, it passes rapidly through esophagus and flushing occurs at the cardia just swallowing, flushing sonographic sign can be detected at the intra- abdominal part of the esophagus, however in case of achalasia flushing is delayed with sonographic evidence of lower esophageal spasm obstruction.

3- In case of hiatus hernia, we observe double anterior and posterior walls of the intra-abdominal part of the esophagus.

Normal esophageal wall thickness were 3.7 ± 0.5 mm in normal population, without significant difference among male and female groups.

All patients underwent upper endoscopy for comparison criteria.

Finally, data were recorded, data entry was done using excel program of windows 10 office 10, after data analysis was done using data mining analysis program; Rapid I, Berlin, Germany, results were obtained in both tables and figures.

Inclusion criteria

- All patients included were above 18 years old to exclude childhood group.
- All patients presented with upper GIT disorders such as epigastric pain, nausea, eructation, halitosis, vomiting, dysphagia; (GI Group)
- All hepatic patients, presented with portal hypertension - induced cirrhosis (Hepatic Group).

Exclusion criteria

- Patients below 18 years old.
- Patients diagnosed previously by upper endoscopy.
- Patients refusing upper endoscopy.
- Patients did not give a written informed consent.

Figure 1: Demonstration of intra-abdominal portion of Esophagus, using left lobe of the liver as acoustic window, esophagus appears as anterior and posterior walls

4 Statistical Analysis

Statistical analysis was done to determine the association between the esophageal wall thickness and the presence of any esophageal diseases/ disorders, detected by upper endoscopy. Hence, the association between two findings is correlated statistically to determine the sensitivity and specificity of 2D U/S to diagnose esophageal lesions prior to diagnostic upper endoscopy.

Categorical data were compared using the x^2 test, whereas continuous variables were compared using Student's t test.

A descriptive model was generated using a decision tree algorithm of data mining analysis program using the Rapid Miner, Berlin, Germany.

Conventional statistics is used to examine a certain hypothesis. In this context we used both Naïve Baÿes (10 folds cross validation) and decision tree model. The descript Naïve Baÿes was generated to decide the most significant independent variable in randomized pattern. However, The Decision tree decides the most significant independent Variable in each stage of predicting dependent variables.

5 Results

In our study, we performed 2D US for (200) patients, divided into: Hepatic and GI groups. Of 100 patients presented with liver cirrhosis, (71) patients showed increased esophageal wall thickness by 2D US, however (29) patients showed normal wall thickness, when correlated with EGD, (69) patients showed esophageal varices and 31 patients showed no varices. Sensitivity was 97.1% and Specificity was 93.5% in hepatic group.

Table 1: showing the overall US data correlated with EGD finding in both Hepatic and GI groups.

Finding	US (NO)	Correlated EGD (NO)	US Overall Accuracy
Esoph. Varices	71	69	97 %
Cancer Esoph.	1	1	100 %
Achalasia	2	2	100 %
Hiatus Hernia	5	5	100 %
GERD	4	10	40 %
Normal	117	113	96.5 %

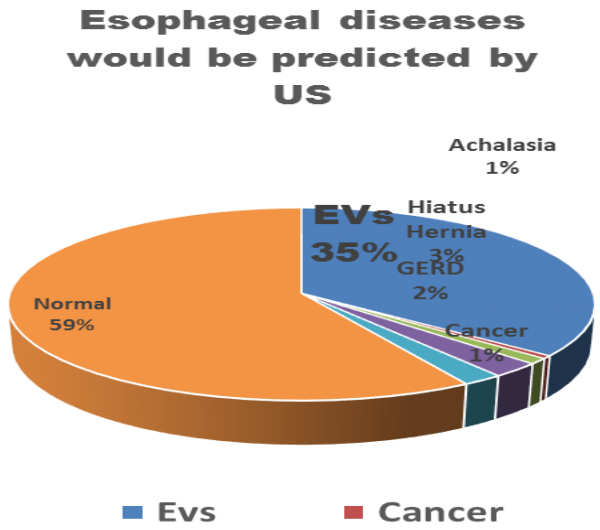

Diagram 1 showing esophageal diseases can be predicted by conventional 2D US. Evs; Esophageal varices, GERD; Gastro Esophageal Reflux disease.

In GI group (88/100) patients were normal esophageal wall thickness by 2D US, correlated by EGD showed normal finding in only 80 patients, however 8 patients showed GERD.

However, (12/100) showed increased esophageal wall thickness as follow:

1-One patient showed a bulk like appearance in the anterior esophageal wall with a normal posterior wall by US. EGD revealed esophageal mass, biopsies were taken and histopathology confirmed the diagnosis as adenocarcinoma of esophagus.

2-Five patients showed double esophageal wall of? Hiatus Hernia, EGD finding was Hiatus hernia.

3-Two patients showed delayed flush test which comparable with Achalasia, EGD confirmed the diagnosis of Achalasia

4-Four patients showed mild increased esophageal wall thickness with inner wall irregularities without sonographic manifestations of portal hypertension, predicting GERD , EGD confirmed the diagnosis in 2 patients only, other two patients were normal.

Sensitivity was 90.9 %, Specificity was 66.6% in GI group.

Mikro = (88.9 %) Over all accuracy; validated by data mining computational analysis.

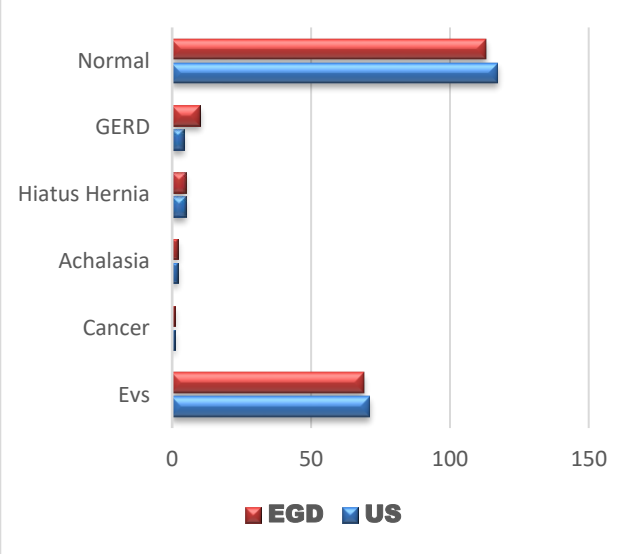

Diagram 2 showing comparable diagnosis between US and EGD.

6 Discussion

The Gold standard investigation modality for esophageal diseases is EGD, however there is an interest in such non-invasive predictors would save time and cost significantly. Two dimensional ultrasound (2D US) uses non-ionizing radiation to create the image and is associated with no side effects or complications using safely during pregnancy. Additionally conventional two-dimensional ultrasonography is easy technique, simple, portable and inexpensive for esophageal screening .The ability to observe the intra-abdominal portion of the esophagus with 2D US has been recognized [3-5]. Routinely, a non-invasive diagnosis of certain esophageal disorders is preferred to invasive endoscopies, especially in certain societies, where esophageal neoplasms and/or esophageal varices are the predominant cause of morbidities and mortalities.

Upper gastrointestinal bleeding because of gastroesophageal varices is a frequent complication of cirrhosis. It is estimated that 50% of patients with cirrhosis present varices, ranging from 40% in patients with compensated cirrhosis to 85% in

those with decompensation criteria .The 1-year probability of bleeding (5–15%) is especially high in patients with large varices (LVs) with red wale markings on the surface. For this reason, the current recommendation is to identify cirrhotic patients with a major risk of bleeding by upper gastrointestinal endoscopy (EGD) at regular periods, yearly in patients with decompensated cirrhosis, and every 2–3 years in the case of compensated cirrhosis. However, endoscopic screening programs are costly and EGD is not always well received by patients [6].

In the United States an estimated 18170 cases of esophageal cancer were diagnosed in 2013, and 15450 deaths are expected from the disease. Worldwide, an estimated 482300 new esophageal cancer cases and 406800 deaths occurred in 2008. In addition, patients with a positive family history of esophageal cancer are screened annually. These approaches place a heavy burden on endoscopy units, and repeated testing over time may have a detrimental effect on patient compliance [7,-14].

Esophageal abnormalities, including, hiatus hernias, and reflux esophagitis, achalasia can also be detected across the intra-abdominal part of the esophagus using 2D US. Thus, the intra-abdominal portion of esophagus should be examined regularly during routine conventional US sessions. Unlike CT, MRI and transient elastography, US uses no ionizing radiation , therefore the technique of choice in pregnant women, patients with contrast allergies, or those in whom MRI is contraindicated. Other major concerns of CT and MRI are the risk of cumulative radiation exposure with repeated screening and cost [15-21].

Identification anterior and posterior walls of the esophagus using flush test is very helpful for such easy demonstration [figure 2], the anterior and posterior walls are hypoechoic, whereas the lumen is hyperechoic.

Thus, US examination of the intra-abdominal esophagus should be the screening test of choice in the evaluation of cirrhotic patients with esophageal varices to decide the best time for interventional therapeutic endoscopy and for other patients with esophageal abnormalities detected by 2D US to refer them for diagnostic upper endoscopy. In this study, we performed 2D US in 200 patients, divided into hepatic and GI groups. The overall accuracy for both groups was (88.9 %) that would be the preferable non- invasive investigation modality for esophageal diseases prediction.

Significantly, this approach does not increase costs because abdominal US has to be performed every 6 months in patients with liver cirrhosis as screening for the appearance of hepatocellular carcinoma and easy to perform for all patient complaining of upper gastrointestinal symptoms. Examination the esophagus using non-invasive 2D US proved to be a helpful tool in saving time and money without invasive complications.

In our study we assessed the esophageal wall abnormalities (intra -abdominal portion) by 2D US, correlated with EGD, analysed results by data mining intelligence computational analysis in (200) patients .

We suggest that 2D US, an inexpensive tool, should be used routinely to screen for esophageal abnormalities in both hepatic and non-hepatic patients.

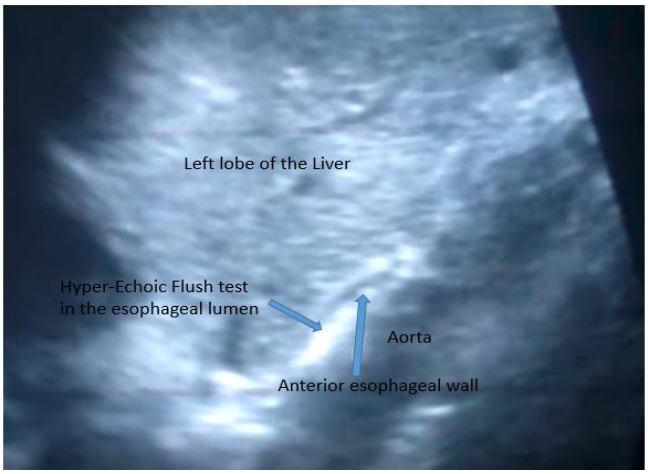

Figure 2: Esophagus during Flush test demonstration.

Conflict of Interest

The authors declare no conflict of interest.

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