

Original article

Diagnostic value of transabdominal hydrosonegography in gastric carcinoma

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Abstract

Aim: To evaluate the efficacy of transabdominal hydrosonegography in the diagnosis of gastric carcinoma.

Materials and Methods: Transabdominal hydrosonegography of the stomach was carried out on fifty patients with clinical suspicion of gastric carcinoma. Endoscopic or peroperative biopsy was taken from pathological sites in all cases. The validity of transabdominal hydrosonegography of the stomach was evaluated as compared to histopathological diagnoses. **Results:** The sensitivity, specificity, accuracy, positive predictive value and negative predictive value of transabdominal hydrosonegography in the diagnosis of gastric carcinoma were 81.82%, 96.43%, 90.00%, 94.74% & 87.10% respectively. **Conclusion:** Transabdominal hydrosonegography is a useful diagnostic modality for the diagnosis of gastric carcinoma.

Key words: Gastric carcinoma, transabdominal hydrosonegography.

Introduction

Gastric carcinoma is the fourth most common cancer worldwide with 930,000 cases diagnosed in 2002.¹ It is more common in men and in developing countries.² Many Asian countries, including Korea, China, Taiwan, and Japan have very high rates of gastric carcinoma. Although it is a common malignant tumour in Bangladesh, no epidemiological study has yet been carried out to find out its prevalence. Incidence of gastric carcinoma is increasing day by day with high prevalence of *Helicobacter pylori* being an important contributing factor.³ It is a disease with a high death rate (about 800,000 per year worldwide) making it the second most common cause of cancer-related deaths in the world.⁴ The high mortality is mainly due to early metastasis before the diagnosis is made and recurrence of the disease after surgical resection. So, an accurate and early preoperative diagnosis as well as follow-up of the patients under treatment is necessary for proper management.

Numerous imaging modalities have been used to diagnose gastric carcinoma. Computed tomography, magnetic resonance imaging, and positron emission tomography have all been used with varying degrees of success⁵. But these modalities are expensive and not widely available in Bangladesh and other developing countries. Endoscopy and upper gastrointestinal series with double-contrast study have significantly improved the diagnostic accuracy in gastric carcinoma but they cannot

assess of the exogastric extension and distant metastases and therefore are unable to assess the surgical resectability preoperatively. Another useful modality is endoscopic ultrasonography which can detect tumour infiltration and metastasis⁶ but is an invasive, relatively complex and expensive procedure and can not be performed successfully in some patients due to obstruction of gastric lumen caused by the tumour or intolerable discomfort of the patient during the examination. Moreover, follow-up of gastric carcinoma requires repeated examinations of the tumour. So a less invasive and cheaper method would be welcome.

Transabdominal ultrasound performed after injection of a hypotonic agent and ingestion of water provides detailed evaluation of the stomach because water provides an acoustic window of transmission to the tissue defining the stomach and adjacent tissues or organs. This technique is referred to as transabdominal hydrosonegography. In transabdominal hydrosonegography, the normal wall of the water-filled stomach is seen as a 5-layer structure.⁷ The wall thickness, echotexture and wall layering can suggest the diagnosis. Localized or circumferential wall thickening more than 5mm in the fundus and body or more than 8 mm in the antrum, hypoechoic mural mass or heterogeneous intraluminal mass with loss of wall layering, luminal narrowing, reduced peristalsis and breached serosa with features of exogastric extension or distant metastasis suggest a malignant lesion while

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increased wall thickness with maintained wall stratification suggests a benign lesion.⁸⁻¹⁴

The efficacy transabdominal hydrosonography in the evaluation of the gastric carcinoma have been studied extensively. Different studies concluded that it is a reliable and accurate diagnostic and staging method of gastric carcinoma^{8,12,15-18} having higher specificity than computed tomography¹⁹⁻²¹ and is comparable to endoscopic ultrasonography in assessing depth of invasion of early gastric carcinoma.²² As ultrasound is often used as the first imaging modality in a large variety of abdominal complaints, clinically unsuspected gastric carcinoma may also be imaged first by it.²³ Moreover this method is also found to be ideal for follow-up of patients under treatment. So, authors recommended it as an initial technique for the diagnosis and follow-up of gastric carcinoma taking into accounts its non-invasiveness, wide-availability, low-cost, easiness-to-use, and lack of radiation load.²⁴ Some investigators, however, recommended further studies.²⁵

As no similar study was carried out before in Bangladesh and it was yet to be known whether this method can be equally useful in Bangladesh with our present knowledge, skill and available instruments, the aim of this study was to assess and validate the diagnostic value of transabdominal hydrosonography in gastric carcinoma.

Materials and methods

This cross-sectional study was carried on 50 patients clinically suspected as gastric carcinoma (32 males 18 females, aged 31-80 years) admitted in the department of Surgery of Dhaka Medical College Hospital, Dhaka during the period of July 2005 to December 2006. 50 of the 62 patients approached for this study agreed and cooperated fully yielding a response rate of 80.65%. The patients were subjected to transabdominal hydrosonography at the department of Radiology and Imaging, Dhaka Medical College Hospital, Dhaka. Sonography was performed first by one investigator which was then confirmed by another investigator. The sonographic findings were noted. The extent of tumour infiltration and metastasis was assessed in all patients with suspected gastric malignancy. 41 patients subsequently underwent endoscopic examination and biopsy was taken from pathological or suspicious sites. In nine patients who underwent surgery without endoscopic

examination operative findings were noted and excision biopsy was carried out from the pathological sites. Tissues of the biopsies were sent to a pathologist for histopathological diagnosis. Transabdominal hydrosonographic diagnoses and histopathological diagnoses were then compared.

The diagnosis of gastric carcinoma was based on the following four criteria:

- i) Localized or circumscribed wall thickening (> 5 mm in the fundus and body or > 8 mm in the antrum) or hypoechoic mural mass or heterogeneous intraluminal mass with /without breached serosa, exogastric extension and distant metastasis.
- ii) Loss of normal wall stratification
- iii) Luminal narrowing.
- iv) Absent or reduced peristalsis.

Ultrasound examinations were performed using real time image units (Toshiba- 400, Siemens-G20, Logic- α 200) with transducer frequency varied between 3.5- 7.5 MHz as required for proper visualization. Patients were examined in empty stomach after overnight fasting or after Ryle's tube aspiration in cases of gastric outlet obstruction. First 20mg Hyoscine N butyl bromide (Butapan) was injected intravenously to achieve optimal distension and to suppress gastric peristalsis. Then patients were given 250 ml to a maximum of 1000 ml of water orally or through Ryle's tube. Transabdominal ultrasonography was performed 3 min after ingestion of water. Patients were examined usually in the supine position. For optimum visualization of lesions at different locations sitting position and left or right lateral decubitus position were also chosen if required. Scanning was done in longitudinal, transverse and left subcostal oblique planes. The appearance of each disorder on US scans was analyzed in terms of wall thickness, wall stratification and the echogenicity of the lesion. Wall thickness was measured by electronic caliper on the transverse view of the most thickened lesion. Liver, pancreas, gallbladder, aorta, spleen, diaphragm, duodenum were also examined for features of metastasis. Ascites and metastatic paraaortic lymph nodes were also looked for. Large (length 2cm or more), irregular, fusiform and inhomogenously hypoechoic lymph nodes were considered as metastatic lymph nodes. Sonographic findings of metastasis were compared with the peroperative findings.

Data was analyzed with the SPSS (Statistical Package for the Social Sciences) version 11.5. Diagnostic value of transabdominal hydrosonography in gastric carcinoma was determined by its sensitivity, specificity, accuracy, positive and negative predictive values.

Prior to commencement of this study, the research protocol was approved by the local ethical committee.

Observations and results

Of the total 50 patients, transabdominal hydrosonography diagnosed 19 as gastric carcinoma and 31 as normal or benign conditions. Histopathology of the biopsied tissues confirmed 22 as gastric carcinoma and the rest 28 as normal or benign conditions. Among the 22 cases of gastric carcinoma, 19 cases (86.36%) were adenocarcinoma. Lymphoma, squamous cell carcinoma and Leiomyosarcoma comprised one case each. 18 cases diagnosed as gastric carcinoma by transabdominal hydrosonography were proved to be correct by histopathological findings but four cases of gastric carcinoma which escaped diagnosis by transabdominal hydrosonography or considered benign were subsequently diagnosed correctly by histopathology. One case suspected as gastric carcinoma by transabdominal hydrosonography was finally diagnosed as a benign condition by histopathology.

Among the 18 cases of gastric carcinoma diagnosed correctly by transabdominal hydrosonography, the commonest site of involvement was the antrum – 10 out of 18 cases (55.56%). Involvement was seen in the fundus in 3 (16.67%) cases, the body in 3 cases and diffuse involvement of the stomach was seen in 2 cases. In one case, two sites of involvement was noted- one in the fundus and the other in the antrum. In all 18 cases (100%) wall layering was completely lost and wall thickness was increased ranging from 10mm to 34 mm with an average of 23.5 mm. Luminal narrowing and reduced

peristalsis was also seen in all cases. Heterogeneous intraluminal masses were seen in 15 out of 18 (83.33%) and serosal breach was seen in 13 out of 18 (72.22%) cases. Gastric carcinoma presented as hypoechoic mural mass in only 5 (27.78%) cases. (Table I).

Table I: Ultrasonographic findings of gastric carcinoma (n=18)

Characteristics	No.	Percentage
Wall layering		
Preserved	0	0%
lost	18	100%
Wall thickness		
Normal	0	0%
Increased	18	100%
Lumen		
Normal	0	0%
Narrow	18	100%
Peristalsis		
Normal	0	0%
Reduced/Absent	18	100%
hypoechoic mural mass		
Present	5	27.78%
Absent	13	72.22%
Intraluminal mass		
Present	15	83.33%
Absent	3	16.67%
Serosa		
Intact	5	27.78%
Breached	13	72.22%

In this study, the sensitivity, specificity, accuracy, positive predictive value and negative predictive value of transabdominal hydrosonography for the diagnosis of gastric carcinoma were 81.82%, 96.43%, 90.00%, 94.74% & 87.10% respectively. The validity parameters are shown in table II.

Transabdominal hydrosonography demonstrated exogastric extension and distant metastasis in 13 patients (Table III). Among them metastatic para-aortic lymph nodes were seen in 5 patients and hepatic metastases was detected in 4 patients. Ascites was seen in 8 patients. Sonography detected involvement of duodenum in 2 patients.

Table II: Validity of transabdominal hydrosonography as diagnostic modality for gastric carcinoma

Test parameter	Estimated value	95% Confidence Interval	
		Lower Limit	Upper Limit
Sensitivity	81.82 %	58.99%	94.01%
Specificity	96.43%	79.76%	99.81%
Accuracy	90.00%	77.41%	96.26%
Positive predictive value	94.74%	71.89%	99.72%
Negative predictive value	87.10%	69.23%	95.78%

Involvement of the gallbladder and hilum of the spleen seen at operation in 1 patient each was not seen preoperatively on sonography.

Table III: Exogastric extent and distant spread of gastric carcinoma as detected by ultrasound (n=13)

Exogastric extent and metastasis	No. of patients
Liver	04
Para aortic lymph nodes	05
Ascites	08
Pancreas	04
Duodenum	02

Discussion

Transabdominal hydrosonography is a simple and rapid technique in which water is introduced to substantially fill the stomach of a fasting patient by ingestion or intubation, preferably the former. To prevent rapid gastric emptying and allow examination while water is present in the stomach of an antispasmodic agent is injected which inhibits peristalsis. The upper abdomen is then scanned with conventional ultrasound diagnostic equipment to produce an image of the stomach and of the upper abdominal organs if required. Because of its sonolucency, water appears dark and makes possible the ultrasonographic visualization of the five distinct layers of the stomach wall: superficial mucosa, deep mucosa, submucosa, muscularis propria, and serosa as alternating hypoechoic and hyperechoic layers. The ultrasonic images may be used to detect extension of gastric carcinoma in the tissues or organs being visualized.

Previous studies indicate that transabdominal ultrasonography can be used effectively in the diagnosis and staging gastric carcinoma. Some researchers consider this method as a supportive and supplementary diagnostic procedure to endoscopy⁸, but others as a reliable screening method for the diagnosis of gastric carcinoma²⁰ which can be a routine diagnostic approach¹⁷ and should rank with the initial methods used for diagnosing gastric carcinoma.²¹ Yet some researchers think that it can be a diagnostic alternatives in selected patients who cannot be stressed by other methods¹⁰ and it is possible to diagnose gastric carcinoma by it despite silent clinical symptoms.²³ According to some, its use in initial evaluation of patients may allow earlier detection of gastric carcinoma.¹⁸ and it can be an alternative method in the follow-up of patients already diagnosed.¹⁶

In this study, the sensitivity, specificity, accuracy, positive predictive value and negative predictive value of transabdominal hydrosonography for the diagnosis of gastric carcinoma were 81.82%, 96.43%, 90.00%, 94.74% & 87.10% respectively. These findings are compared with those of one past study in table IV.

Table IV: Validity parameters of present study compared with a previous study

Validity parameters	Present study	Tous & Busto
Sensitivity	81.82%	77.8%
Specificity	96.43%	99.1%
Accuracy	90.00%	-
Positive predictive value	94.74%	94.9%
Negative predictive value	87.10%	95.5%

In both of the studies it is obvious that transabdominal hydrosonography has high validity parameters that make it useful as a diagnostic method of gastric carcinoma.

In the present study increase in wall thickness, complete loss of wall stratification, luminal narrowing and reduced peristalsis was observed in all cases of gastric carcinoma. Heterogeneous intraluminal masses were seen in 15 out of 18 cases (83.33%). Gastric carcinoma presented as hypoechoic mural mass in only 5 (27.78%) cases. In rest of the cases, gastric wall showed hypoechoic intramural infiltration and thickening. Breach of serosa was seen in 13 out of 18 (72.22%) cases. In two cases of gastric carcinoma, diffuse circumferential wall thickening was seen- one was a case of scirrhus carcinoma, another gastric lymphoma. The sonographic features of gastric carcinoma found in this study are similar to that of the previous studies.⁸⁻¹⁰ Transabdominal hydrosonography demonstrated exogastric extension and distant metastasis of gastric carcinoma in 13 patients.

In this study, 4 cases of gastric carcinoma could not be diagnosed by transabdominal hydrosonography which were subsequently diagnosed correctly by histopathology. In one case the tumour was too small to be detected by sonography and in three cases small tumours located at the fundus and gastro-esophageal junction could not be visualized by sonography. In our study, most of the cases of gastric carcinoma diagnosed correctly by hydrosonography were in advanced stage of the

disease with a relatively large tumour. It is obvious that transabdominal hydrosonography can miss detection of very small lesions and lesions at certain locations e.g. fundus and gastro-esophageal junction.

Pancreas is a common organ invaded by gastric carcinoma. In this study, metastasis of the pancreas was identified in four patients by transabdominal hydrosonography. The above four cases of metastasis was confirmed at surgery. In addition 2 patients having pancreatic metastasis undetected by transabdominal hydrosonography were detected at surgery. In one patient pancreas was invaded slightly. In the remaining one, the tail of pancreas was invaded which was not detected by sonography due to interference of bowel gas and ribs.

Transabdominal hydrosonography failed to detect involvement of duodenum seen at operation in two patients. Correct diagnosis was made preoperatively in 2 of 4 patients with duodenum invasion by transabdominal hydrosonography. It is necessary to fill duodenum by water for the assessment of duodenum. Because tumour caused gastric lumen obstruction, duodenum was not filled adequately and not visualized clearly leading to misdiagnosis. Involvement of the gallbladder and hilum of the spleen seen at operation in one patient each was not seen preoperatively on sonography. Splenic hilum could not be observed completely with hydrosonography leading to the detection failure.

In this study liver metastases were seen in four patients. Tumours invading liver located in anterior wall of stomach or lesser curvature and were close to the liver. The relationship between tumour and liver could be visualized clearly by using ultrasonographic beam through liver without interference of bowel gases. Ascites was seen in eight patients, only five of these patients had presented clinically.

Para-aortic lymphadenopathy was identified at sonography in five patients. Very small lymph nodes were undetectable with transabdominal hydrosonography. In addition, bowel gas was unfavorable for detection of lymph nodes.

Thus, though sonography misdiagnosed or underdiagnosed the presence and exogastric extent of gastric carcinoma in a few cases, it did provide accurate diagnosis and a rough estimate of its extent in the majority of the cases. The possible reasons for misdiagnosis or underdiagnosis were as follows:

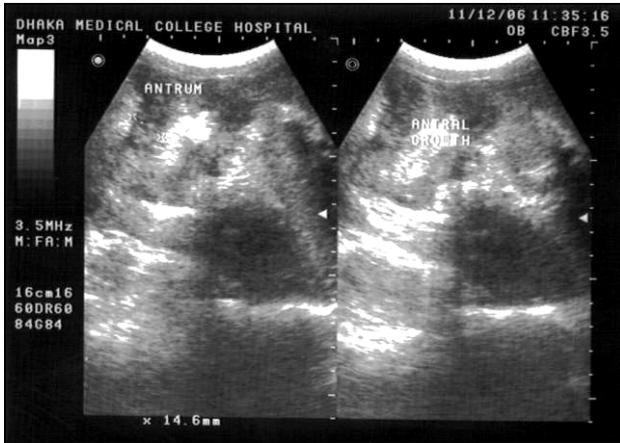
(1) the procedure did not practice adequately, because the investigators had limited experience of this procedure. (2)The transducers that were available and used in this study had frequencies up to 7.5MHz. So resolution more than this limit was not technically possible. Higher resolution is needed for optimal visualization of small lesions. (3) Location of gastric carcinoma also affected the diagnosis. Transabdominal hydrosonography may fail to correctly diagnose carcinoma located in gastric fundus or cardia. Three cases of gastric carcinoma not diagnosed correctly by hydrosonography in this study were located in the above locations. (4) Location of the involved organs and size of the metastases also affects the diagnosis of exogastric extension. For example, it is difficult to clearly visualize the hilum of the spleen and the tail of the pancreas by transabdominal hydrosonography. Invasions of the tail of pancreas in one patient and hilum of the spleen in another were not detected with transabdominal hydrosonography in this study. Very small metastases were also undetected by hydrosonography. Moreover, this study involved only a limited number of patients. A larger study population could have given more precise results regarding diagnostic validity of this method.

Conclusion

This study concluded that transabdominal hydrosonography is a useful diagnostic modality for the diagnosis of gastric carcinoma and to assess its exogastric invasion and validates the related previous study findings regarding its efficacy.



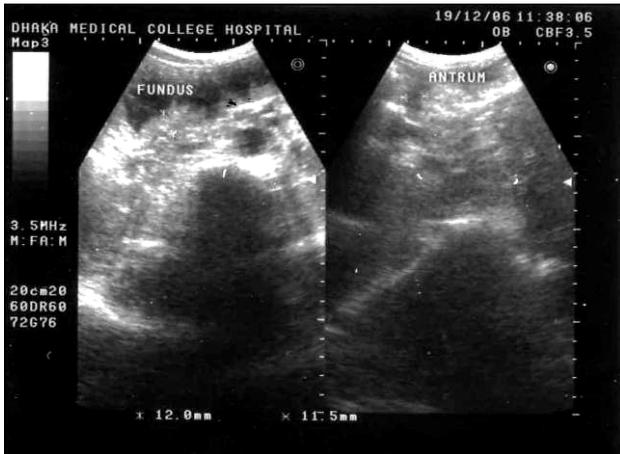
Sonograph 1: US image of scirrhous carcinoma showing diffuse hypoechoic wall thickening with loss of stratification



Sonograph 2: Ultrasound showing gross hypoechoic wall thickening with luminal narrowing in the region of the antrum. Serosa appears intact-carcinoma antrum



Sonograph 3: Transverse scans of the fluid filled stomach showing hypoechoic circumferential wall thickening and loss of wall layers-gastric lymphoma



Sonograph 4: Sonogram of the fluid filled stomach showing two heterogeneous intraluminal masses, one in the fundus and the other in the antrum with complete disruption of wall layering in the region of the masses with breach of serosa - carcinoma stomach



Sonograph 5: Sonogram of the fluid filled stomach showing a heterogeneous intraluminal mass in the body with complete disruption of wall layering in the region of the mass- carcinoma stomach. Huge ascites is also seen

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