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Diagnostic methods in dyspepsia: the usefulness of upper abdominal ultrasound and gastroscopy

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Objectives – To examine the diagnostic value of gastroscopy and upper abdominal ultrasound, which are frequently used as primary tests in dyspeptic patients in general practice. To test the influence of age for accuracy of both diagnostic methods.

Design – Clinical study.

Setting – Four health centres in Kuopio Province, Finland.

Subjects – Four hundred unselected consecutive dyspeptic patients (91 less than 45 years of age) who consulted their general practitioners.

Main outcome measures – Sensitivity, specificity, positive and negative predictive values (PV), efficiency and usefulness index (UI) were calculated for upper abdominal ultrasound and for gastroscopy in detecting the causes of dyspepsia in primary care. Final diagnosis was determined after one year follow-up.

Results – The sensitivity of upper abdominal ultrasound in detecting the cause of dyspepsia was 0.07, the specificity 0.91,

PV+ 0.36, PV– 0.56, and UI –0.001. Ultrasound was not more efficient in older patients. Gastroscopy was the most efficient method with a sensitivity of 0.75, specificity 1.00, PV+ 0.99, PV– 0.83 and UI 0.56. The usefulness of gastroscopy was even better among patients over 45 years of age.

Conclusions – The usefulness of upper abdominal ultrasound is low regardless of patient's age. Gastroscopy is superior to upper abdominal ultrasound as a first line diagnostic method in diagnosing dyspepsia, especially among patients over 45 years of age.

Key words: dyspepsia, endoscopy, general practice, ultrasound, usefulness, sensitivity, specificity.

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Dyspepsia is a heterogeneous condition including different underlying causes such as gastro-oesophageal reflux, peptic ulcer, malignancy, gallstone disease, lactose intolerance, and functional dyspepsia. Although upper abdominal complaints are very common in primary care, it is difficult to make an accurate aetiological diagnosis of dyspepsia. The diagnosis of dyspepsia cannot reliably be based on the history (1,2), and the question of which patients warrant further investigation is often discussed with enthusiasm (3,4). Increased health costs also bring pressure on general practitioners (GPs) to consider more carefully how to investigate their patients. Attempts to help decision making by computer-based analyses (5) have not become popular in practice.

Gastroscopy and upper abdominal ultrasound (ultrasound) are the most commonly performed diagnostic investigations in patients with dyspeptic symptoms. The use of ultrasound has become surprisingly popular in general practice. As many as 67% of the chief physicians in health centres in central Finland would choose ultrasound as a primary investigation in dyspepsia (6). Also in the Netherlands GPs referred their dyspeptic patients more often for ultrasound investigations than for gastroscopy at the first consultation (7). Ultrasound

is not unpleasant for the patients and it is easy to perform (8), but its usefulness as a diagnostic test in patients with dyspepsia has not been evaluated.

The diagnostic accuracy of clinical examination has recently been studied in acute appendicitis (9), acute cholecystitis (10), and acute small bowel obstruction (11). Since only limited information is available about the usefulness of gastroscopy and ultrasound as diagnostic tests in dyspepsia, these tests were evaluated in a series of 400 unselected dyspeptic patients consulting a primary care physician.

MATERIALS AND METHODS

Patients

Four hundred unselected, consecutive dyspeptic patients were referred to the study by GPs working at four health centres between January 1993 and January 1994. Of the study patients 91 were less than 45 years of age. The background population was 24 600 in the area of Kuopio University Hospital. The definition by Colin-Jones et al. (12) was used for dyspepsia. All the patients included in our study had abdominal or retrosternal pain, discomfort, heartburn, nausea, vomiting, or other

Table I. Age related final diagnoses determined after investigations and one year follow-up.

Final diagnosis	Age years	
	15-44	≥45
Reflux oesophagitis	12 (13%)	46 (15%)
Symptomatic gastro-oesophageal reflux	9 (10%)	38 (12%)
Peptic ulcer disease	5 (5%)	55 (18%)
Gallstone disease	2 (2%)	7 (2%)
Coeliac disease	1 (1%)	1 (0.3%)
Giardiasis	3 (3%)	2 (0.6%)
Malignancy	0	9 (3%)
Lactose intolerance	18 (20%)	17 (5%)
Functional disorders	39 (43%)	133 (42%)
Other	2 ¹ (2%)	7 ² (2%)

¹ Other includes: 1 dysfunction of sphincter of Oddi, 1 dyspepsia less than a month in duration

² Other includes: 3 dyspepsia with major abdominal operation done previously, 2 erosive gastritis, 1 chronic pancreatitis and 1 candida oesophagitis.

symptoms considered to be referable to the proximal alimentary tract. A detailed description of the patients, the diagnostic criteria, and the spectrum of the final diagnoses (Table I) has been reported previously (13).

Criteria for final diagnoses

GPs examined the study patients, but regardless of the findings, all patients underwent gastroscopy with routine biopsies from the lower duodenum, duodenal bulb, antral and body parts of the stomach as well as from specific findings), ultrasound, and laboratory tests (blood count, S-alanine aminotransferase, S-alkaline phosphatase, S-amylase, C-reactive protein, and a test for lactose intolerance). Histological specimens were examined by two pathologists experienced in gastrointestinal histopathology. Ultrasound examinations were performed by a physician experienced in ultrasound (H.R.). Gastroscopies with biopsies were performed by one specialist (M.H.), who also interviewed the patients. The final diagnoses (Table I) were decided after completion of testing and follow-up one year after the first visit. All the study patients had follow-up visits at one month and one year. A combination of all the tests (gastroscopy, ultrasound, blood tests, and follow-up) was the basis for the final diagnoses and was used as a "gold standard". At the follow-up visits some of the study patients needed extra examinations for verification of the diagnoses; gastroscopy was performed again in 11 patients, and the lower gastrointestinal tract was examined by barium enema, colonoscopy, or sigmoidoscopy in 30 patients. These extra examinations did not reveal missed diagnoses of the upper gastrointestinal tract, nor diseases of the lower tract that might have explained the symptoms.

Functional dyspepsia was defined as chronic or recurrent abdominal pain or discomfort centered in the upper abdomen with a duration of at least one month and with symptoms persisting at least 25% of the time. No evidence of organic disease to explain the symptoms was allowed (14). The diagnosis of the patients with heartburn or regurgitation as a predominant symptom with no endoscopic evidence of oesophagitis was categorized as symptomatic gastro-oesophageal reflux (14). Functional dyspepsia, symptomatic gastro-oesophageal reflux, and irritable bowel syndrome (15) as the causes for dyspepsia were categorized into the *functional disorder* group. Because few erosions have no obvious clinical relevance (16), we chose as a cut-off limit ten erosions, and patients with less than ten small superficial erosions were included in this group. *Peptic ulcer* was defined as an ulcer at least 5 mm deep in the stomach or duodenum at endoscopy. In the present study *peptic ulcer disease* also included erosive duodenitis, because that type of duodenitis appears most likely to be an ulcer-equivalent (17). *Gallstone disease* was diagnosed if gallstones were found by upper abdominal ultrasound, and if the symptoms could be attributed to gallstone disease according to the criteria defined in the Working Team report (18). Biliary colic was defined arbitrarily as a steady pain lasting more than 15 to 30 minutes, usually located in the epigastrium and/or radiating to the back. Episodes of pain occur irregularly, separated by symptom-free intervals of weeks to years, and varying in intensity. *Lactose intolerance* was diagnosed when the lactose intolerance test was pathological, and in conjunction with the test the patient experienced symptoms for which he or she had come for consultation, and/or symptoms disappeared on a lactose free diet.

The sensitivity, specificity, efficiency, predictive values (PV), and usefulness index (UI) of the diagnostic methods were calculated (9-11):

$$\text{Sensitivity} = \text{Tp}/(\text{Tp} + \text{Fn})$$

$$\text{Specificity} = \text{Tn}/(\text{Tn} + \text{Fp})$$

$$\text{Efficiency} = (\text{Tp} + \text{Tn})/(\text{Tp} + \text{Tn} + \text{Fp} + \text{Fn})$$

$$\text{PV+} = \text{Tp}/(\text{Tp} + \text{Fp})$$

$$\text{PV-} = \text{Tn}/(\text{Fn} + \text{Tn})$$

$$\text{Tp} = \text{true positive diagnosis}$$

$$\text{Tn} = \text{true negative diagnosis}$$

$$\text{Fp} = \text{false positive diagnosis}$$

$$\text{Fn} = \text{false negative diagnosis}$$

Efficiency is a measure of the potential discriminating effect of a test prior to the results of the test being known, and, because efficiency is dependent on the prevalence of disease, the estimated efficiency of the test can be extrapolated only to other populations with a similar prevalence of disease.

The positive predictive value (PR+) of the test shows

the probability of a patient having the disease when the test result is positive. The negative predictive value (PV-) of the test represents the probability of a patient not having the disease when the test is negative.

The UI is defined as $d \times (d-r)$, where d is the incidence of the finding in the disease (= sensitivity), and r is the incidence of the finding in a reference population (1-specificity). It ranges from -1 to 1, and tests in which the UI values are greater than 0.35 are regarded as useful (11).

Testing ultrasound and gastroscopy

Values described above were calculated for ultrasound and gastroscopy in two age groups: patients under and over 45 years of age. In the evaluation of sensitivity and specificity, negative diagnoses were considered to be functional disorders.

RESULTS

Sensitivity, specificity, efficiency, PV+, PV-, and UI values in detecting dyspepsia by using ultrasound or gastroscopy are presented, by two different age groups, in Table II. Ultrasound had low sensitivity and efficiency and PV- values in both age groups. Specificity was high in both age groups, as well as PV+ under age of 45. UI was also low by ultrasound in both older and younger age groups. UI was highest in patients over 45 years of age investigated by endoscopy. PV+, PV- and efficiency values were also in favour of gastroscopy. According to the parameters tested, gastroscopy was most useful among older patients.

Minor findings in both ultrasound and gastroscopy, which were considered to have no clinical relevance and were not regarded as true or false positive findings, are listed in Table III and Table IV. One patient had a small carcinoma, found incidentally in the kidney by sonography, but the operative treatment did not produce changes in the patient's symptoms.

Table II. Sensitivity (Sens), specificity (Spec), efficiency (Effic), predictive values (PV+ and PV-), and usefulness index (UI) of upper abdominal ultrasound and gastroscopy in detecting the causes of dyspepsia in two different age groups.

Test	Ultrasound			Gastroscopy		
	Age (years)			Age (years)		
	<45	≥45	Total	<45	≥45	Total
Sens	0.05	0.07	0.07	0.50	0.82	0.75
Spec	1.00	0.88	0.91	1.00	0.99	1.00
Effic	0.56	0.54	0.54	0.77	0.92	0.88
PV+	1.00	0.32	0.36	1.00	0.99	0.99
PV-	0.55	0.56	0.56	0.70	0.87	0.83
UI	0.003	-0.004	-0.001	0.25	0.66	0.56

Table III. Minor findings by ultrasound.

	Number of patients
1. Hepatomegaly	46
2. Fatty liver	37
3. Signs of liver cirrhosis	1
4. Benign focal lesions in the liver	33
- cysts	30
- haemangioma	3
5. Operated gallbladder	49
6. Elongation or sclerosis of abdominal aorta	9
7. aneurysm of abdominal aorta (diam. 3 cm)	1
8. Benign kidney lesions	52
9. Operated spleen	1
10. Renal carcinoma	1

Table IV. Minor findings by gastroscopy.

Gastroscopy	Number of patients
1. Hiatal hernia without oesophagitis	37
2. Benign oesophageal polyps	8
- submucosal tumours	3
- fibroepithelial	1
- hyperplastic	1
- inflammatory	1
- papilloma	1
3. Erosions in the stomach (less than 10) without ulcer or oesophagitis	35
4. Benign polyps in the stomach	13
5. Histological gastritis	257

DISCUSSION

Dyspepsia is a considerable diagnostic problem in the field of gastroenterological diseases faced in general practice, a major issue being when and how to investigate a dyspeptic patient (3,4,12,14). The most difficult problem in studying causes of dyspepsia is obviously the lack of a "gold standard". To overcome this problem in the present study we used combined information from gastroscopy, ultrasound, laboratory screening, patient's history, physical examination, and a one year follow-up as a basis for the final diagnosis of dyspepsia.

Our results showed that ultrasound had a low sensitivity in examination of dyspepsia. In general, most of the values tested were not significantly different between the age groups studied. UI and PV+ values were also very poor if all patients are taken into account, and the relatively high PV+ in the younger patients may have resulted from the suggestion that their gallstones were causing the dyspeptic symptoms. Thus ultrasound has minor value as a first line diagnostic method. The negative predictive value for ultrasound was also small-

er than for gastroscopy (0.56 vs. 0.83). Therefore, the clinical value of a negative result in ultrasound is uncertain, regardless of the patient's age, and it is surprising that ultrasound is popular as a first line investigation in general practice (6,7). Some authors recommend performing ultrasound before making a diagnosis of functional dyspepsia (12,14). Advantages of ultrasound in investigating recurrent abdominal pain have been studied, but the results were clinically quite unhelpful (8). On the other hand, negative results have also been considered as valuable information in handling patients with uncharacteristic abdominal pain (8). In our study material 21 patients with gallstones were supposed to have "silent" gallstones. Two of them had peptic ulcer and six gastro-oesophageal reflux disease as a cause for their symptoms. Thirteen cases were diagnosed as functional disorders. Our data agree with other observations that gallstone disease is a relatively rare cause of symptoms in dyspeptic patients (19). In population-based studies it has been shown that even 80% of gallstones are silent (20). The fact that up to 34% of patients who have been operated on because of gallstones still have their abdominal complaints also supports this (21). Other incidentally found lesions such as benign cysts or haemangiomas might also lead to unnecessary investigations and so increased health costs.

Knowing the proportions of diseases causing dyspepsia (13,19), gastroscopy should be the most frequently performed investigation. Our data clearly show the superiority of endoscopy compared with ultrasound as a diagnostic method when investigating chronic upper abdominal complaints. The results were clear-cut whichever aspect of a diagnostic test was studied (sensitivity, specificity, efficiency, PV+, PV-, or UI). In agreement with earlier observations (12,14) our results clearly demonstrate that, for the investigation of dyspepsia, gastroscopy is more valuable in patients aged 45 years or older than in younger patients. The diagnosis of dyspepsia in older patients, like the diagnosis of acute abdominal pain, also differs in many aspects from that in younger patients (22). Peptic ulcer disease and malignancy were more frequently found in older dyspeptic Finnish patients than in the younger ones. Incidentally found lesions at gastroscopy, such as benign polyps, usually do not need further investigations, except histological biopsies. This kind of finding does not usually explain a patient's symptoms.

In the management of dyspepsia in primary care gastroscopy or ultrasound are not necessary for all patients. However, it is generally known that the differential diagnosis of dyspepsia, when based solely on physical findings and patient's medical history, is extremely difficult. In this type of clinical study, both gastroscopy and ultrasound are necessary to investigate the clinical usefulness of these methods.

In conclusion, our results clearly show the limitations

of ultrasound as a diagnostic method in unselected dyspeptic patients in general practice. The usefulness of ultrasound is not better among patients over 45 years of age. The study confirms that gastroscopy in patients over 44 years of age is even more useful than in younger patients. The modest results of ultrasound are explained by the rare occurrence of diseases that can be diagnosed by ultrasound (e.g. gallstone disease, chronic pancreatitis, pancreatic cancer) as a cause of dyspeptic symptoms.

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