

Esophageal clearance scintigraphy, in diabetic patients—a preliminary study

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The aim of this preliminary study was to evaluate the predictive value of esophageal clearance scintigraphy (ECS) in the diagnosis of esophageal autonomic neuropathy in diabetic patients without any esophageal symptoms. A single swallow ECS was performed in 12 diabetic patients and 15 normal volunteers, and esophageal transit time (ETT) and esophageal (Es) T 1/2 values were calculated. ETT and Es T 1/2 were found to be significantly prolonged in the diabetic group ($p < 0.01$ and $p < 0.05$, respectively). In this preliminary study, our results strongly suggest that ECS may be an important noninvasive diagnostic tool in the evaluation of diabetic patients with asymptomatic esophageal autonomic neuropathy.

Key words: diabetes mellitus, esophageal clearance scintigraphy, autonomic neuropathy

INTRODUCTION

AUTONOMIC NEUROPATHY is a frequent complication of diabetes mellitus which can result in gastrointestinal, cardiovascular, genitourinary and peripheral autonomic dysfunctions. Esophageal dysfunction secondary to gastrointestinal autonomic neuropathy is usually asymptomatic in the early stages; but it can cause retrosternal pain and dysphagia in the later stages.¹⁰ Esophageal fluoroscopy and cine-esophagography, acid clearance test and esophageal manometric studies are other tests which are used in the evaluation of esophageal motor dysfunction, but each of them has certain disadvantages.^{2,5} However, esophageal radionuclide studies have been reported as noninvasive, sensitive and quantitative tests in this regard.^{11,4}

In this study we investigated the value of ECS in the diagnosis of esophageal dysfunction in diabetic patients without esophageal symptoms.

MATERIALS AND METHODS

Patients

Twelve diabetic patients [10 NIDDM (non-insulin dependent diabetes mellitus), 2 IDDM (insulin dependent diabetes mellitus); 6 males and 6 females; age 55.5 ± 11.0 (mean \pm SD)] without any esophageal symptoms and with normal esophagoscopies were studied. Ten patients had physical signs of peripheral neuropathy and in 9 patients nerve conduction velocity (NCV) was found to be decreased. The duration of diabetes was 15 ± 11.0 years (Mean \pm SD).

The control group consisted of 15 normal volunteers [5 females and 10 males; age 41.5 ± 16.3 (mean \pm SD)] without any esophageal symptoms. Informed consent was obtained before study in all normal volunteers and patients.

Study protocol

The scintigraphic study was performed after at least 3 hours of fasting in the sitting position. Anterior images were taken; the head of the patient being in the right lateral position in order to separate oropharyngeal and esophageal activities clearly. The patient was given a mixture of 5 ml water with 0.5 mCi (18.5 MBq) Tc99m-DTPA and the study was performed following a single swallow. In order to obtain accurate results, careful attention to the details

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of the procedures and patient rehearsal were accomplished. A Toshiba digital gamma camera with a low energy high sensitivity (LEHS) collimator was used. The images were taken at a rate of 0.5 second/frame for a total of 120 frames.

Data analysis

Time activity curves were generated from pharyngeal, esophageal, esophago-cardiac junction and gastric regions of interest (ROIs) (Fig. 1). Esophageal transit time (ETT) was calculated as the length of time from the initial entry of the bolus into the esophagus to the point of at least a 90% decrease in radioactivity. T 1/2 values were calculated from the descending portion of the clearance curve of pharyngeal and esophageal ROIs. Tmax values were obtained from the peak points of pharyngeal, esophageal, esophago-cardiac junction and gastric curves.

Statistical analyses were performed by Student's T-test.

RESULTS

The clinical data and scintigraphic results for the diabetic patients are shown in Table 1. The ETT, Es T 1/2 and stomach Tmax values for the normal and the diabetic group are shown in Fig. 2. Among the parameters studied, ETT and Es T 1/2 were found to be significantly prolonged in the diabetic group, whereas Tmax values in pharyngeal, esophageal, stomach and esophagocardiac junction and pharyngeal T 1/2 values did not differ significantly in the diabetic and control groups (Table 2). The mean \pm SD ETT values were 5.08 ± 1.3 sec and 7.5 ± 2.1 sec in the normal and the diabetic groups, respectively ($p < 0.01$). The Es T 1/2 values for the normal

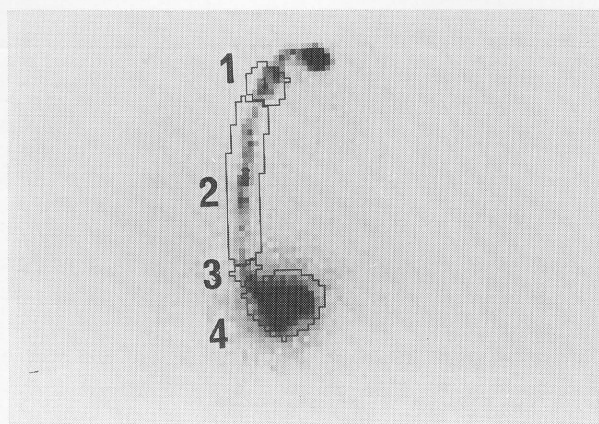


Fig. 1 Composite image taken from single swallow demonstrating regions of interest (1: Pharyngeal ROI, 2: Esophageal ROI, 3: Esophago-cardiac junction ROI, 4: Gastric ROI).

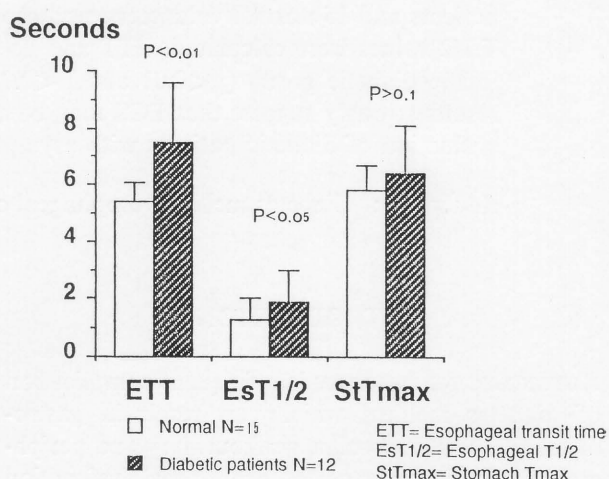


Fig. 2 The ETT, Es T1/2 and St Tmax values in normal and diabetic groups.

Table 1 Clinical data and scintigraphic results in diabetic patients

No.	Age	Sex	DM		NCV	EsT 1/2 (sec)	ETT (sec)
			Type	Duration			
1	55	F	IDDM	35	D	1.1	5.0
2	35	M	NIDDM	10	N	1.3	7.5
3	74	F	NIDDM	17	D	4.7	10.5
4	63	M	NIDDM	25	D	3.1	8.5
5	59	F	NIDDM	27	D	2.3	11.5
6	69	F	NIDDM	25	D	0.9	6.5
7	49	M	IDDM	10	D	1.3	6.5
8	61	M	NIDDM	10	D	2.0	9.0
9	53	M	NIDDM	13	D	2.2	8.0
10	57	F	NIDDM	5	N	1.0	4.5
11	50	M	NIDDM	1	N	1.5	6.0
12	41	M	NIDDM	2	D	1.6	6.0

EsT 1/2: Esophageal T 1/2. ETT: Esophageal Transit Time. NCV: Nerve Conduction Velocity (N=Normal; D=Decreased). NIDDM: Non-Insulin Dependent Diabetes Mellitus. IDDM: Insulin Dependent Diabetes Mellitus.

Table 2 Scintigraphic results of the diabetic and control groups

Groups	Pha. T 1/2	T Max (Mean±SD)			
		Eso.	Pha.	ECJ	Sto.
Normal (n=15)	0.4±0.6	1.1±0.6	0.7±0.3	3.6±1.0	5.7±1.2
DM (n=12)	0.3±0.1	1.3±0.4	0.8±0.3	3.9±1.4	6.4±1.7
P	>.10	>.10	>.10	>.10	>.10

ECJ: Esophago Cardiac Junction, DM: Diabetes Mellitus, Eso: Esophageal, Pha: Pharyngeal, Sto: Stomach

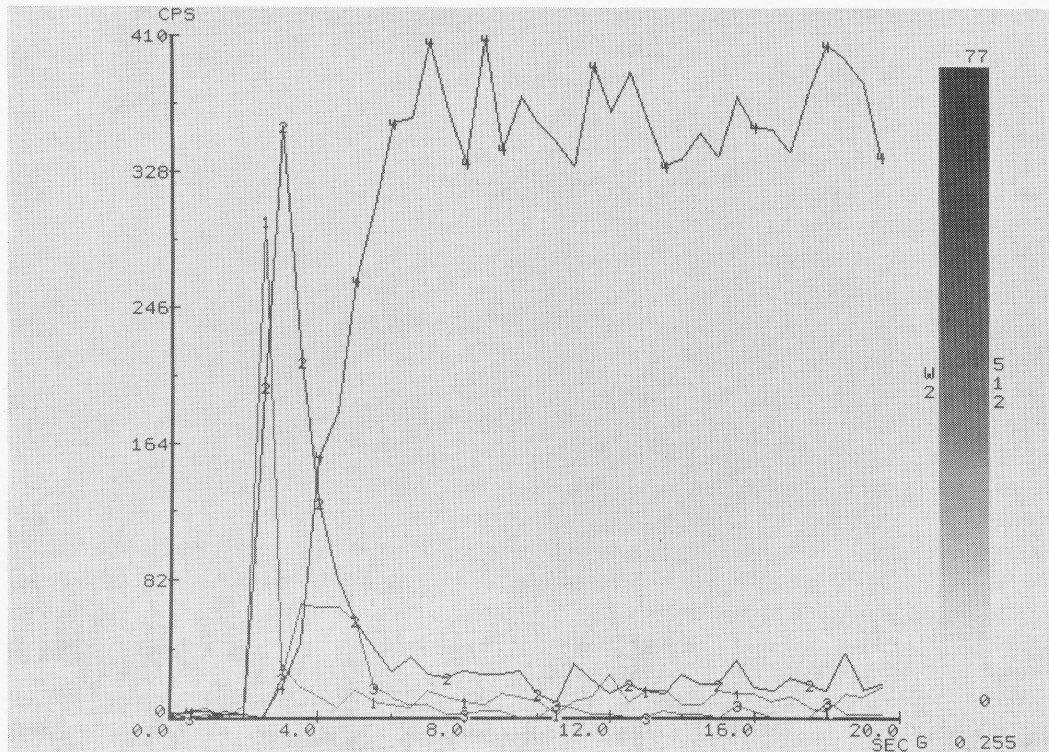


Fig. 3 A radionuclide transit graph of a normal subject. Rapid clearance in the esophageal curve is evident (1: Pharyngeal curve, 2: Esophageal curve, 3: Esophagocardiac junction curve, 4: Gastric curve).

and diabetic groups were 1.4 ± 0.4 sec and 1.9 ± 1.1 sec ($p < 0.05$). Six out of 12 (50%) diabetic patients had prolonged ETT. Five of these 6 patients (83%) had decreased NCV. The duration of diabetes in these 6 patients with prolonged ETT was 17 ± 7 years (mean±SD) which was slightly longer than that of patients having normal ETT values, but statistically not significant (13 ± 14 years; $p > 0.1$).

A radionuclide transit graph of a normal subject is shown in Fig. 3. Note the sharp decline of the esophageal curve and the absence of a second peak in the pharyngeal curve which indicates a single swallow. Figure 4 shows an abnormal transit graph of a diabetic patient with a prolonged ETT and multiple peaks in the esophageal curve which denotes disorganized bolus transit. Figure 5 shows a prolonged ETT but a normal pattern in the esophageal curve for a diabetic patient.

DISCUSSION

Esophageal dysfunction secondary to diabetic autonomic neuropathy is usually asymptomatic in the early stages, and with conventional techniques it can be detected in only 50% of diabetic patients. The motility disturbances are consistent with advanced vagal neuropathy³ and appear to result from pre-ganglionic parasympathetic damage including axonal degeneration and destruction of the myelin sheaths.⁹

Although esophageal manometry is a sensitive (83%) and gold-standard test in detection of esophageal dysfunction, it cannot be used as a screening test because of its invasive nature. Radiographic techniques are relatively less sensitive (35–45%),^{1,2,4} more subjective and not quantitative. Esophageal scintigraphy has been reported as a sensitive, non-invasive and quantitative method in the detection of

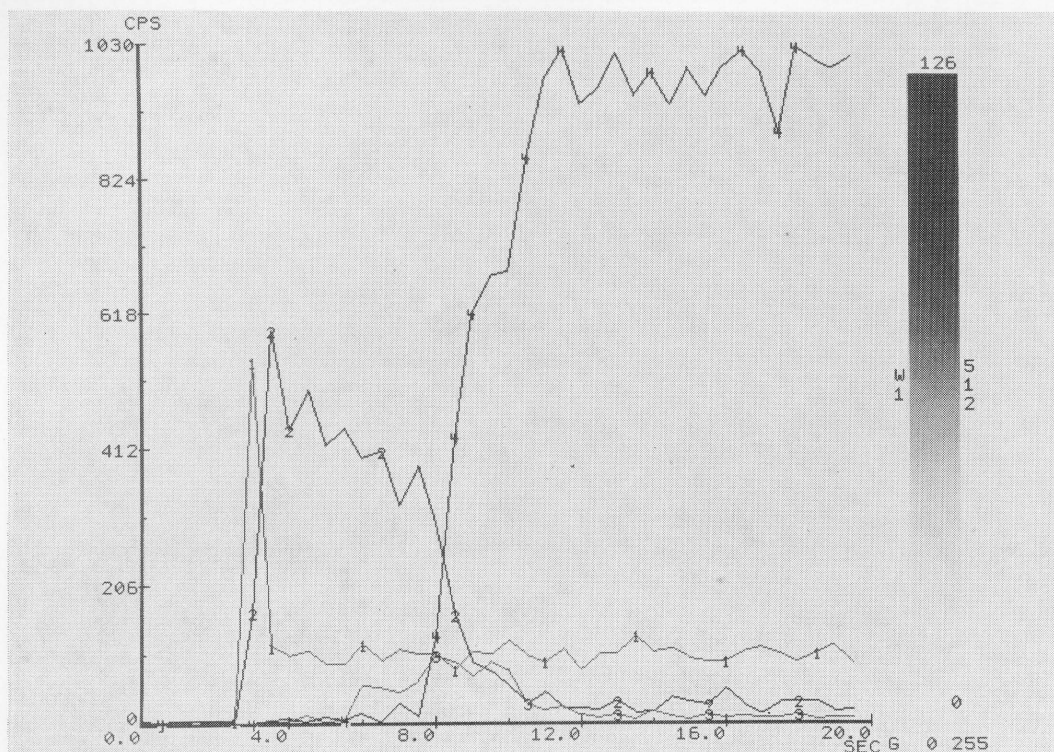


Fig. 4 An abnormal transit graph of a diabetic patient. Note the multiple peaks and prolonged ETT in the esophageal curve (Curve 2).

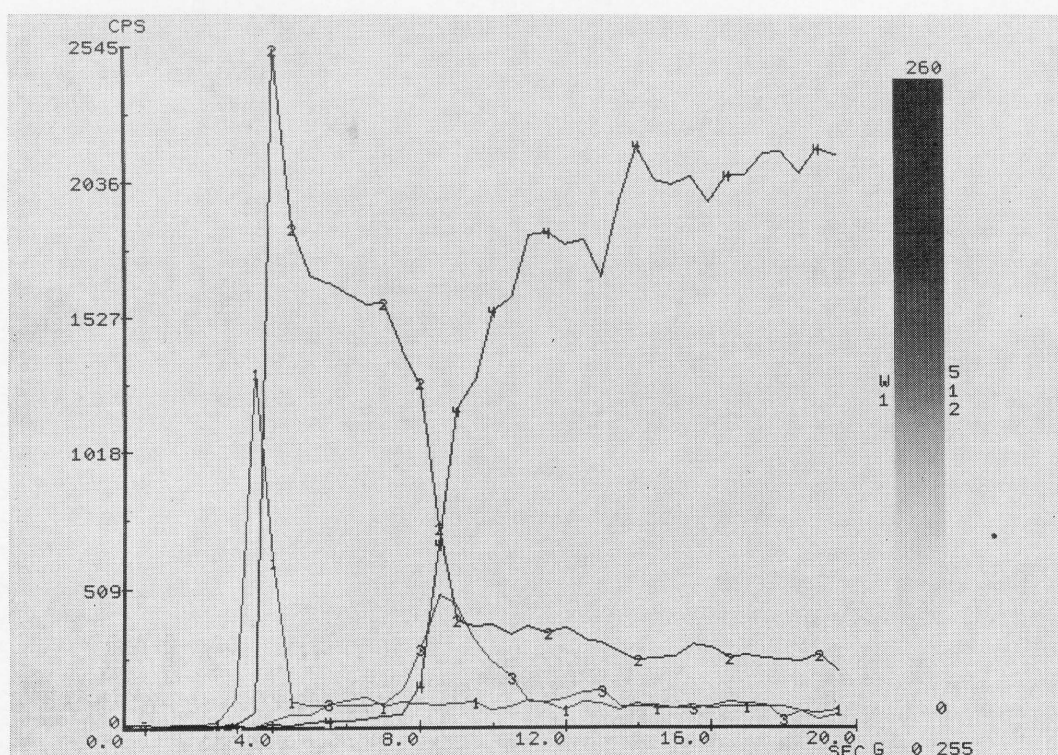


Fig. 5 Prolonged ETT but normal pattern of esophageal curve in a diabetic patient (Curve 2).

esophageal dysfunction, and recently it has been recommended by some authors as a screening test.¹¹ The concordance between radionuclide and manometric studies was found to be 71% in a recent study.⁵ Esophageal transit time was first measured by Tolin,¹² and since then, numerous modified techniques have been proposed for the detection of esophageal motility disorders.^{7,8}

We have used a single swallow ECS and found that both ETT and Es T 1/2 were significantly prolonged in diabetic patients who had no esophageal symptoms. Of the 6 patients with prolonged ETT, 5 had decreased NCV, suggesting that esophageal autonomic neuropathy might coexist with peripheral neuropathy with a high degree of probability. This finding is in accordance with the results of Hollis et al. who found that 80% of diabetic patients with peripheral neuropathy had abnormal esophageal motility.⁶ In order to evaluate the influence of the duration of diabetes on the incidence of esophageal autonomic neuropathy we searched for the correlation between these parameters. Although the mean duration of diabetes was slightly increased in patients with prolonged ETT, this was not statistically significant. We think that further studies are required in this respect.

Factors that can decrease the sensitivity of ECS, such as increased lower esophageal sphincter pressure or an increase in the amplitude or duration of the primary peristaltic wave, are not present in diabetic autonomic neuropathy,⁸ and ECS might be a sensitive method to use in the diagnosis of esophageal dysmotility. Our finding of increased ETT and Es T 1/2 in asymptomatic diabetic patients supports this concept.

In conclusion, our preliminary study suggest that ECS may be an important diagnostic tool in the evaluation of asymptomatic patients with esophageal autonomic neuropathy.

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