DIABETES RESEARCH AND CLINICAL PRACTICE 97 (2012) 77–81

Contents available at Sciverse ScienceDirect

Diabetes Research and Clinical Practice

journal homepage: www.elsevier.com/locate/diabres

International Diabetes Federation

Esophageal body motility in people with diabetes: Comparison with non-diabetic healthy individuals☆

João Xavier Jorge [a,*], *Edgard Augusto Panão* [b], *Mário Amaral Simões* [a], *Cláudia Iracema Cardoso Borges* [c], *Fernando Jorge Delgado* [d], *Álvaro Correia Coelho* [d], *Amílcar Lima Silva* [d], *Carlos Costa Almeida* [a]

[a] *Faculty of Medicine, University of Coimbra, Portugal*
[b] *Service of Gastroenterology, Hospital Centre of Coimbra, Portugal*
[c] *Service of Internal Medicine, Hospital of Leiria, Portugal*
[d] *Service of Internal Medicine, Hospital Centre of Coimbra, Portugal*

ARTICLE INFO

Article history:
Received 15 November 2011
Received in revised form
23 January 2012
Accepted 30 January 2012
Published on line 2 March 2012

Keywords:
Esophagus
Motility
Diabetes
Healthy individuals

ABSTRACT

Aims: The aim of this study was to compare esophageal motor characteristics between diabetics and healthy individuals.

Methods: Esophageal manometry was performed in 34 type 2 diabetics and 32 healthy individuals. Waves were evaluated in the 3 thirds of the esophagus (P1 = upper, P2 = middle, and P3 = distal).

Results: In diabetics vs. controls, wave distribution was as follows: peristaltic waves, $83.5 \pm 22.2\%$ vs. $96.3 \pm 4.4\%$, $p < 0.002$; simultaneous waves, $3.26 \pm 5.8\%$ vs. $0.53 \pm 1.3\%$, $p < 0.01$; no transmitted waves, $10.62 \pm 20.7\%$ vs. $2.75 \pm 3.0\%$, $p < 0.002$; and retrograde waves, $2.68 \pm 4.0\%$ vs. $0.31 \pm 1.1\%$, $p < 0.03$. Wave amplitude was similar between groups. Average upstroke (mmHg/s) in diabetics vs. non-diabetics was P2, 33.8 ± 13.9 vs. 40.2 ± 17.7, $p < 0.03$; and P3, 29.8 ± 15.3 vs. 41.3 ± 14.0, $p < 0.002$.

Conclusions: (1) Simultaneous waves, no transmitted waves, and retrograde esophageal waves were significantly more frequent in diabetics. (2) Average upstroke was significantly lower within the middle and distal esophagus of diabetic individuals. (3) Wave amplitude was similar in both groups.

1. Introduction

Esophageal dysmotility, as well as gastroparesis, appears to be common in patients with diabetes [1–6], particularly those with gastrointestinal symptoms [7–9]. However, some such patients may have no esophageal or gastrointestinal symptoms [10,11]. Alterations in the motor activity of the esophagus have been observed in healthy individuals in several studies. The presence of ineffective or simultaneous esophageal waves appears to be common in healthy individuals and, within specific limits, can be considered normal [12,13]. Further, it has been observed that maximum active tension in healthy individuals deteriorates as a function of age and that the esophagus becomes stiffer with age. Changes such as increased stiffness and reduced primary and secondary peristalsis have been observed in the esophagus of healthy

☆ *Grant support*: This study was supported by the Enterprise Sonangol.
* *Corresponding author at*: Urbanização Nova Conímbriga II, lote B1, r/c posterior, 3150-220 Condeixa-a-Velha, Portugal.
Tel.: +351 239100907; fax: +351 239100907.
E-mail address: cambombo@hotmail.com (J.X. Jorge).
0168-8227/$ – see front matter
doi:10.1016/j.diabres.2012.01.036

individuals, with deterioration of esophageal function evident after the age of 40 years [14].

In patients with diabetes, the magnitude of these alterations is unclear, as is the correlation with gastrointestinal symptoms and the impact on quality of life. Studies have verified that, in diabetic patients, alterations in esophageal motility may be associated with slow gastric emptying [15], in individuals with or without neuropathy [16–19]. On the other hand, other studies have shown that symptoms of gastroesophageal reflux may not be correlated with esophageal dysmotility in diabetic patients [20]. Some authors believe that the alterations in the biomechanical properties of the esophagus observed in diabetics reflect, to some extent, intra-structural tissue alterations caused by the disease [21]. Reduced sensitivity to esophageal stimulation [22] and an increased frequency of distension-induced contractions have been shown to correlate with the duration of the disease, and diminution of longitudinal and radial compressive stretch [23] have been described. In diabetics with neuropathy, increased esophageal sensory thresholds have been observed compared to controls, evidencing altered central processing to visceral stimulation with involvement of both peripheral and central mechanisms [24]. Some authors have argued that the effect of acute hyperglycemia itself does not influence the esophageal sensitivity in patients with longstanding diabetes and autonomic neuropathy [25]. A decrease in the amplitude of esophageal contractions, the absence of primary peristalsis, high-frequency simultaneous or repetitive body contractions, and a decrease in the velocity of peristalsis are some of the many esophageal alterations that have been revealed [26,27]. However, 1 study comparing diabetics and non-diabetics showed no difference in the rate of acid reflux and the risk of esophageal mucosa damage [28]. Moreover, only few differences in esophageal motility have been observed between diabetics and healthy individuals [29]. Therefore, the aim of this study was to compare specific esophageal body motor characteristics of type 2 diabetic patients with those of non-diabetic healthy individuals.

2. Materials and methods

2.1. Subjects

A group of 34 type 2 diabetic patients (15 women and 19 men) with a mean age of 57.5 ± 7.9 years and 32 non-diabetics (12 women and 20 men) with a mean age of 58.8 ± 10.7 years underwent stationary computed esophageal manometry. All individuals participated voluntarily and provided written informed consent. The study was approved by the Ethical Committee of the hospital where it took place. The mean duration of diabetes was 12.6 ± 8.5 years. The HbA1c (mean $\pm$ SD) was $8.21\% \pm 2.05$; the fasting plasma glucose was $8.69 \pm 3.16\%$. The mean body mass index (BMI) was 30.9 in diabetics and 26.6 in non-diabetics, with a very significant difference ($p < 0.002$). At the time of the investigation, diabetic patients were taking oral hypoglycemics (metformin, 13 patients or gliclazide, 7 patients), insulin, 6 patients, or insulin plus an oral hypoglycemic 8 patients. No patient was taking dipeptidil peptidase inhibitors. On the day of the examination, diabetic patients took their medications only after the procedure. Pregnant women, patients who had undergone anterior gastrointestinal surgery and those with signs of autonomic neuropathy according to the coefficient of variation of the R–R interval (CVRR) by electrocardiography were excluded from the study. The CVRR was obtained according the methods descript by Castro et al. [30] and the normal range of RR interval during the expiration divided by RR interval during the expiration, >1.1, referred by Castro et al. [31]. No patient was taking medications that altered gastrointestinal motility. The number of individuals with symptoms of heartburn or reflux was 9 (26.67%) in diabetics and 6 (21.87%) in non-diabetics with no significant difference observed between groups, any patient related difficulty in swallowing. No patient had a diabetic nephropathy or retinopathy.

No esophageal endoscopy, pHmetry or motor nerve conduction velocity (MCV) was performed to any participant, and it could be considered a limitations.

2.2. Procedure

Stationary computed esophageal manometry with a water perfusion system from Medical Measurement System (MMS), UPS 2020 ULGI, Netherlands, 2000, was performed in all participants. The examination was conducted using a 6-channel catheter based on the manometric technique and normality criteria of Katz et al. [32] and Richter et al. [33]. During the manometric examination, participants were in the decubitus dorsal position. The catheter was inserted through the nose into the stomach; it was then adjusted so that the last channel was positioned on the inferior esophageal sphincter. Because the sphincter has a higher pressure than the stomach and esophageal body lumen, we ensured that the 3 proximal catheter doors (P1, P2, and P3) were positioned in the lumen of the esophageal body. The distance between the 3 proximal channels or catheter doors was 5 cm. Participants were encouraged to relax for approximately 1 min before we began the examination. The participants were then asked to drink 5 mL of natural water. The computed system automatically registered manometric waves during swallowing, which was repeated 10 times for each individual. Each of 3 proximal catheter doors registered the activity of one-third of the esophagus (P1: proximal esophagus, P2: middle esophagus, and P3: distal esophagus, 2.5 cm above the inferior esophageal sphincter IOS). The esophageal waves registered by the 3 proximal channels were evaluated based on their characteristics, amplitude, average and maximum upstroke, velocity, and duration, all of which were automatically calculated by the computer.

Data were analyzed with SPSS using the Student's *t*-test and Mann–Whitney test-for non-parametric variables, and are presented as mean $\pm$ standard deviation.

3. Results

The wave distribution in diabetic vs. control participants was as follows: peristaltic waves, $83.5 \pm 22.2\%$ vs. $96.3 \pm 4.4\%$, $p < 0.002$; simultaneous waves $3.26 \pm 5.8\%$ vs. $0.53 \pm 1.3\%$,