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Original Article

Gastric emptying and gastro-oesophageal reflux in children with cystic fibrosis☆

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Abstract

Background: Gastro-oesophageal reflux (GOR) is common in patients with cystic fibrosis (CF). The aim of this study was to investigate the relationship between gastric emptying (GE) and GOR in children with CF.
Methods: Multichannel intraluminal impedance-pH monitoring (MII-pH) to measure GOR and GE breath test (GEBT) to measure GE were performed in 28 children with symptoms suggestive for GOR disease (GORD) (group 1). GEBT was performed in another 28 children with/without GOR symptoms who agreed to undergo GEBT but not MII-pH (group 2).
Results: In group 1, we found increased acid GOR (AGOR) in 46.4% and delayed GE (DGE) in 21.4% but no relationship between increased AGOR and DGE. There was no DGE in group 2. We found DGE in 10.7% and rapid GE in 12.5% of the whole group.
Conclusions: Almost half of the children with CF and symptoms suggestive for GORD have increased AGOR and almost a quarter has DGE. However, there was no relation between GOR and GE.

Keywords: Gastric emptying; Gastro-oesophageal reflux; Cystic fibrosis; Children; Multichannel intraluminal impedance-pH monitoring; ^{13}C-gastric emptying breath test

Abbreviations: GOR, Gastro-oesophageal reflux; CF, Cystic fibrosis; GE, Gastric emptying; MII-pH, Multichannel intraluminal impedance-pH monitoring; GEBT, Gastric emptying breath test; AGOR, Acid gastro-oesophageal reflux; DGE, Delayed gastric emptying; GI, Gastrointestinal; GORD, Gastro-oesophageal reflux disease; NAGOR, Nnon-acid gastro-oesophageal reflux; NGE, Normal gastric emptying; RGE, Rapid gastric emptying; ^{99m}TS, ^{99m}Technetium scintigraphy; ^{13}C-OBT, ^{13}C-octanoic acid breath test; ^{13}C-ABT, ^{13}C-acetate breath test; PI, Pancreatic insufficiency; PS, Pancreatic sufficiency; BMI, Body mass index; FEV1, Forced expired volume at 1 s; PPI, Proton pump inhibitors; LOS, Lower oesophageal sphincter; MII, Multichannel intraluminal impedance; MII-GOR, Multichannel intraluminal impedance gastro-oesophageal reflux; MII-AGOR, Multichannel intraluminal impedance acid gastro-oesophageal reflux; MII-NAGOR, Multichannel intraluminal impedance non-acid gastro-oesophageal reflux; RI, Refluxindex; IRIS, Infra Red Isotope; $t_{1/2}$-GE, Gastric half emptying time; P90, Percentile 90; P10, Percentile 10.

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1. Introduction

Cystic fibrosis (CF) is an inherited disease affecting not only the lungs but also the entire digestive system. Gastrointestinal (GI) symptoms are the most important non-pulmonary manifestations of this disease.

Gastro-oesophageal reflux (GOR) and GOR disease (GORD) are more frequent in adults and children with CF compared with healthy controls. Most GOR studies in patients with CF have been performed with pH-metry which measures only acid GOR (AGOR). Multichannel intraluminal impedance-pH monitoring (MII-pH) measures AGOR and non-acid GOR (NAGOR) which can be both increased in CF. Delayed gastric emptying (DGE) can contribute to GOR. DGE, normal GE (NGE) as well as rapid GE (RGE) have been reported in adults and children with CF [1–3].

The "gold standard" to measure gastric emptying (GE) is ^{99m}Technetium scintigraphy (^{99m}TS) which is associated with a radiation exposure [4]. For this reason, alternative non-radioactive methods using the stable isotope ^{13}C have been developed. The ^{13}C-octanoic acid breath test (^{13}C-OBT) to measure GE of solids and the ^{13}C-acetate breath test (^{13}C-ABT) to measure GE of liquids were developed [5,6]. We have recently validated the ^{13}C-ABT and the ^{13}C-OBT against ^{99m}TS in children with upper GI symptoms and established normal values for the GE of liquids and solids in healthy children measured with the ^{13}C-ABT and the ^{13}C-OBT (submitted).

To the best of our knowledge, there is only one study in adults (n = 20) and one study in children (n = 15) with CF where MII-pH and GE assessment were both performed in the same patients. Both studies showed an abnormal MII-pH and DGE in 67% and 33% of the adults, and in 54.8% and 33.3% of the children, respectively, but found no correlation between DGE and increased GOR except for a subgroup of adults with DGE and increased acidic duodenogastro-oesophageal reflux [7,8]. The aim of this study was to investigate in children with CF (1) GOR measured with MII-pH, (2) GE measured with GE breath test (GEBT) and (3) the relationship between GOR and GE.

2. Material and methods

2.1. Subjects

This prospective study was performed in 56 children with CF. MII-pH was performed in 28 children selected on the basis of GI symptoms (belching, epigastric pain, heartburn, regurgitation, vomiting) and/or respiratory symptoms (signs of unexplained respiratory evolution despite maximal therapy) suggestive for GORD. A GEBT was also performed in these patients (group 1). GEBT alone was performed in another 28 children with CF with/without GOR symptoms selected on the basis that they agreed to undergo a GEBT but not MII-pH (group 2) (Table 1). The diagnosis of CF had been made on the

Table 1
Group 1 (multichannel intraluminal impedance-pH monitoring and gastric emptying breath test) and group 2 (gastric emptying breath test alone): patient characteristics.

	Group 1 (MII-pH + GEBT) (n = 28)	Group 2 (GEBT alone) (n = 28)	p group 1 versus group 2
Age (years)	4.4 (1–17)	9.0 (4–14)	0.001
Gender (boys/girls) (n)	14–14	18–10	0.280
Pancreas function (PI/PS) (n)	21–7	17–11	0.252
Genotype			0.884
F508del homozygous (n)	11	9	
F508del heterozygous (n)	7	9	
Others (n)	5	4	
Unknown (n)	5	6	
Weight (kg)	16.0 (6.2–55.0)	27.5 (16.0–53.0)	0.001
Weight SDS (Z-score)	−1.02 (−3.15; 1.26)	−0.47 (−2.60; 1.89)	0.007
Height (cm)	107.0 (61.0–159.4)	132.5 (105.0–175.0)	0.001
Height SDS (Z-score)	−0.66 (−6.94; 2.23)	−0.12 (−2.15; 2.99)	0.029
BMI (kg/m²)	15.0 (11.5–22.3)	15.6 (13.2–21.0)	0.252
BMI SDS (Z-score)	−1.06 (−3.70; 2.97)	−0.50 (−2.11; 2.04)	0.188
FEV1% predicted	95.0 (39.2–129.6)	97.5 (37.8–123.1)	0.487
Colonisation with			
Pseudomonas aeruginosa (n)	7	8	0.763
Staphylococcus aureus (n)	18	23	0.131
Upper GI symptoms (n)	14	10	0.280
Meconium ileus (n)	4	5	0.716
Intake PPI (n)	12	5	0.042
Intake prokinetics (n)	8	5	0.342
Intake azithromycin (n)	2	2	1.000
Intake insulin (n)	2	1	0.553
Intake laxatifs (n)	14	15	0.789
Intake ursodeoxycholic acid (n)	7	5	0.515

Legend: MII-pH: multichannel intraluminal impedance-pH monitoring; GEBT: gastric emptying breath test; PI: pancreatic insufficiency; PS: pancreatic sufficiency; BMI: body mass index; FEV1: forced expired volume in 1 s; GI: gastrointestinal; PPI: proton pump inhibitors.