THE CAIRN SPIRULINA GEBT FOR GASTROPARESIS

THE CAIRN ^{13}C-SPIRULINA GASTRIC EMPTYING BREATH TEST

Cairn Diagnostic's Gastric Emptying Breath Test (GEBT) is a non-invasive, non-radioactive, easily administered test to aid in the diagnosis of gastroparesis. Gastroparesis is characterized by delayed gastric emptying in the absence of a mechanical obstruction in the stomach. This syndrome is a form of gastric paralysis that may cause nausea, vomiting, early satiety and other upper gut symptoms. The true prevalence of gastroparesis is unknown but it is estimated to occur in 20 – 40% of individuals with diabetes mellitus in the United States.

Gastroparesis also occurs in a significant percentage of patients with functional dyspepsia and in patients with gastroesophageal reflux disease (GERD). It also occurs in some patients with neurological disease, autoimmune disorders or thyroid dysfunction. Gastroparesis is sometimes also induced by viral illness and by some medications, particularly from narcotic and anticholineraic agents and glucagon like peptide-1 (GLP-1) amylin analogs among diabetics.[1]

Traditionally, gastroparesis is diagnosed using a scintigraphy test that requires the patient to to consume radiolabeled (radioactive) foods and must be administered in specialized outpatient centers. The Cairn GEBT is validated against this traditional method of diagnosis, is not radioactive and requires no special training, precautions or referrals. The GEBT can be performed in any clinical setting and is the only FDA-approved rule-in test for gastroparesis.

The GEBT is designed to show how rapidly the stomach empties by measuring carbon dioxide in a patient's breath. The test is conducted over a four-hour period after an eight-hour fast. Pre-meal breath samples are collected at the start of test. Patients then eat a special test meal that includes a precisely formulated mixture of dehydrated scrambled eggs and pharmaceutical-grade Spirulina, a safe, nutritional blue-green algae that has been enriched with carbon-13 during manufacturing. Once the test meal is consumed, the carbon-13 in the test meal gives rise to carbon-13 labeled carbon dioxide (CO_2), or $^{13}CO_2$, which is exhaled by the patient. Changes in the ratio of carbon-12 to carbon-13 carbon dioxide can be measured in the patient's post-meal breath samples and used to arrive at a diagnosis for gastroparesis.

TECHNOLOGY BEHIND THE CAIRN GEBT

When patients receive the Cairn GEBT, they consume a meal containing carbon-13 (or ^{13}C) labeled Spirulina. As they digest the meal, this ^{13}C-Spirulina is triturated by the stomach to a particle size of 1 – 2 mm and passes through the pylorus into the intestine. In the upper small intestine, the labeled products of ^{13}C-Spirulina digestion (proteins, carbohydrates and fats) are absorbed and subsequently metabolized, resulting in ^{13}C-labeled carbon dioxide expired in the breath. Breath samples, collected periodically in capped glass tubes before and after test meal administration, are returned to a central laboratory for analysis by gas isotope ratio mass spectrometry (GIRMS) to determine the ratio of $^{13}CO_2$ to $^{12}CO_2$ in each sample.

By measuring the change in this ratio over time as compared to the pre-meal value, the rate of $^{13}CO_2$ excretion can be calculated and the patient's gastric emptying rate determined. The rate of gastric emptying is proportional to the rate of $^{13}CO_2$ excretion at any measurement time "t."

Cairn GEBT results are reported using the metric "kPCD." At any measurement time t, kPCD(t) = 1000 X [Percent carbon-13 dose (PCD) in test meal excreted (as $^{13}CO_2$) per minute].

A larger kPCD value means a faster $^{13}CO_2$ excretion rate which is proportional to a faster rate of gastric emptying.

Once the clinical laboratory has assayed each of the patient's breath samples, test results are presented as $^{13}CO_2$ excretion curves, depicting excretion rate (kPCD per minute) over time. Increasing rates of $^{13}CO_2$ excretion (kPCD min^{-1}) reflect increasing rates of gastric emptying. The location and shape of the patient's curve relative to the reference range provide data for identifying gastroparesis.

CAIRN DIAGNOSTICS™

1. Source: American College of Gastroenterology, Management of Gastroparesis Guidelines - http://gi.org/guideline/management-of-gastroparesis/

Exhibit I: Subject with NORMAL rate of gastric emptying

Subjects with NORMAL rates of gastric emptying (Exhibit I) typically display kPCD values that exceed time-specific cut-off point(s) (COPs), reach a maximum kPCD value between 120 and 180 minutes, and then decline.

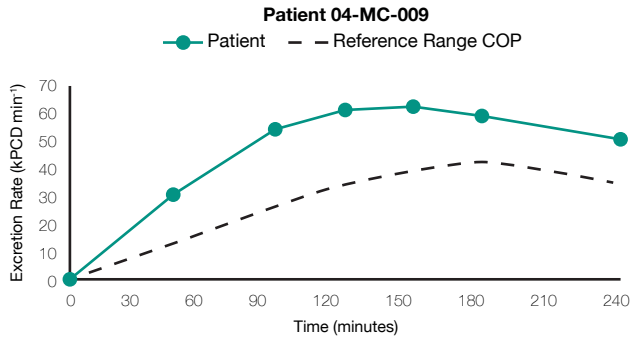


Exhibit II: Subject with DELAYED rate of gastric emptying

In contrast, kPCD values of DELAYED patients (Exhibit II) are lower and typically rise continuously throughout the four-hour evaluation period. As a result, their highest kPCD value will occur at four hours.

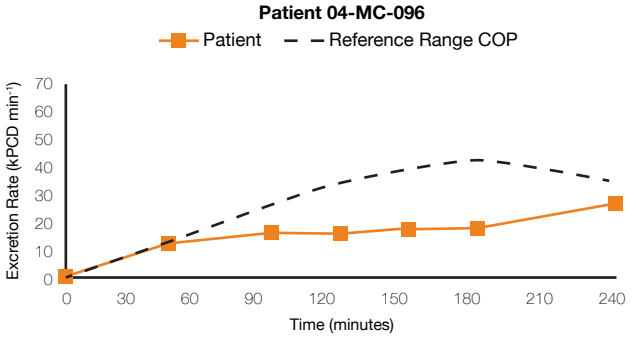
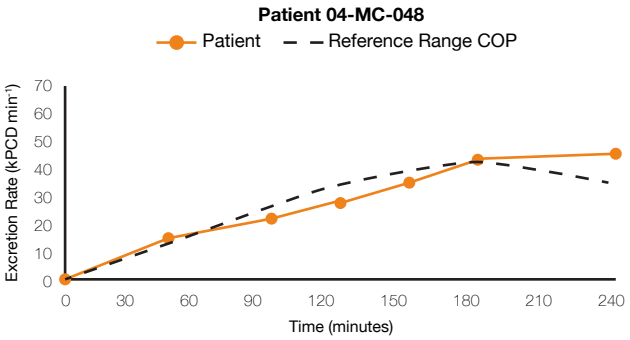


Exhibit III: Subject with MODERATELY DELAYED gastric emptying

Because excretion curves of patients with NORMAL rates of emptying are typically declining at 180 – 240 minutes (as is the reference range derived from healthy subjects) and those of DELAYED patients are still rising at 180 and 240 minutes, kPCD values of MODERATELY DELAYED patients (Exhibit III) may rise through the cutoff points at 180 and 240 minutes. Nevertheless, the continuously rising curve with peak excretion occurring at 240 minutes is indicative of delayed emptying as verified by scintigraphy in the GEBT validation study.



Gastroparesis is best identified by observing if the patient's kPCD values at either the 90, 120 or 150 minute time points are below the respective COPs, and/or if the patient's maximum kPCD value occurs at 240 minutes.

ABOUT CAIRN DIAGNOSTICS

For many patients and physicians, the pathway to a definitive diagnosis can be complex, slow and frustrating. At Cairn Diagnostics our mission is to develop tests that eliminate complexity and create a safer, faster and clearer path to diagnosis.

Use of our patented and validated analytical methods allows us to create diagnostic tests that are user- and patient-friendly and easy to administer, yet powerful in their ability to deliver a definitive diagnosis.