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Impedance Probe Monitoring to Diagnose Reflux

by Susan Agrawal

Your child has a pH probe—a standard test to diagnose reflux over 24 hours—and vomits 10 times, spits up 20 times, coughs, gags, and retches several times. He cries a lot and seems to have difficulty breathing on several occasions. You expect that the test will show he has severe reflux and are utterly shocked when the test comes back normal, showing mild reflux within the normal and expected range. How could that much vomiting, coughing, and spitting up be *normal*?

Whether or not the test is normal, there is definitely a problem with your child. But is the problem with the test or does your child just not have reflux? In the past, the most common method of definitively diagnosing reflux was the pH Probe, a test that only measures acid in the esophagus. This method is slowly being replaced by the Impedance Probe, a new technique that measures both pH and impedance, or the change in flow between points within the esophagus.

From the parent's perspective, the standard pH Probe and the Impedance Probe are very similar tests. Both involve a small tube placed in one nostril and threaded into the esophagus. Both monitor reflux over a period of 20-24 hours on average, with the parent using a recorder to note episodes of reflux, irritability, and other common reflux symptoms.

The type and amount of information gathered, however, is much different between the two tests. The pH Probe only monitors pH, usually in one or two spots in the esophagus. If liquid enters the esophagus and has a pH less than 4, it is considered an episode of acid reflux on a pH Probe. pH Probes only monitor acid reflux. A child whose reflux is non-acidic from medication, meals, or normal variants of stomach secretions may have a perfectly normal pH Probe, even if he vomited and spit up 100 times during the test. In addition, pH Probes are limited by the very fact that reflux often occurs shortly after a meal is consumed, and in most cases, the food or formula consumed will raise the pH of the gastric contents above 4. None of these episodes would be picked up by a pH Probe as a reflux episode. While doctors have tried to counter these limitations by removing children from reflux medication prior to testing and in some cases restricting food intake to acidic foods and liquids, ultimately the pH Probe is unable to detect more than 50% of reflux events in the average child.

Impedance Probes have improved detection of reflux episodes dramatically. By recording changes in flow as well as the pH of the esophagus, the Impedance Probe is

able to detect subtle changes in the esophagus, including non-acid reflux and even the passage of air. These events are monitored at several different levels of the esophagus as well, allowing for a more accurate understanding of whether reflux is reaching the throat or mouth. A recent article on pediatric impedance monitoring describes the physics behind the technique:

Impedance is the resistance to the flow of current between two points. Basic physics reminds us that resistance to current flow is usually higher between electrodes submerged in air than between electrodes submerged in liquid. Using this principle, researchers in industry and clinical medicine have developed an instrument capable of measuring impedance continuously at multiple sites in the esophagus.

Liquid of any pH, gas, and gas-liquid mixtures cause typical changes in the baseline impedance of the empty esophageal lumen. A sudden increase in esophageal impedance suggests that gas is surrounding the electrode pair; a sudden decrease suggests that liquid surrounds the electrode pair; and a mid-level decrease suggests mixed contents. By watching the progression of impedance changes up or down a linear array of several pairs of electrodes, the clinician can determine the direction of fluid flow and distinguish a swallow from a reflux event.ⁱ

During testing, parents either press a button on the recorder or note on paper events such as spitting up, vomiting, burping, coughing, gagging, and retching. These events are then correlated with both the pH readings and the impedance results to determine an overall picture of both acid and non-acid reflux, burping, and related reflux symptoms.

Several studies have found that non-acid reflux in particular may be associated with respiratory symptoms such as coughing, changes in breathing, and choking. In one such study, 312 of 364 reflux episodes were associated with respiratory changes, but only 12% of these 312 events were acid reflux. On a standard pH Probe, little association between these reflux and respiratory problems would have been made, while on an Impedance Probe, a very strong correlation is indicated. Another study that looked at coughing showed 45% of reflux episodes associated with coughing were non-acid reflux and would only be detected by Impedance Probe.ⁱⁱ

Yet another study looked at 34 babies with reflux symptoms, only four of whom had abnormal pH Probes. 20 of these babies had significant correlation (more than 50%) between symptoms and reflux events on Impedance Probe, such as coughing, arching, and fussiness, with about half of the events resulting from non-acid reflux.ⁱⁱⁱ

Nonetheless, Impedance Probes have their limitations. They only record a 20 to 24 hour period, and multiple studies have demonstrated that two separate days of monitoring may vary dramatically. The technology is still young and is difficult to interpret, causing varied interpretations among doctors, depending on skill level and personal bias. In addition, little data exists on what amount of acid and non-acid reflux is actually normal,

making it difficult to determine when reflux reaches the point of being pathological. Impedance probes are also very costly and time-consuming to interpret.

For children with mild uncomplicated reflux, an Impedance Probe probably is not necessary. But for children with more severe reflux, respiratory symptoms without clear origin, and other associated reflux problems, an Impedance Probe is the best test currently available to accurately determine if a child is refluxing and if that reflux is causing additional related symptoms.

ⁱ Judith M. Sondheimer. Esophageal impedance monitoring: What a new test tells us about infants who reflux. *Contemporary Pediatrics* 2006;23 #1:40-8.

ⁱⁱ Studies cited and analyzed in Yvan Vandenplas, et al. Will Esophageal Impedance Replace pH Monitoring? *Pediatrics* 2007;119 #1:119-22.

ⁱⁱⁱ Cited in Sondheimer.