

## Is Wireless Capsule pH Monitoring Better Than Catheter Systems?

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**Article:** Bravo 48-hour wireless pH monitoring in patients with non-cardiac chest pain. Objective gastroesophageal reflux disease parameters predict the responses to proton pump inhibitors

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(*J Neurogastroenterol Motil* 2012;18:169-173)

Since 1980, catheter-based 24-hour ambulatory pH monitoring has been most commonly used to diagnose gastroesophageal reflux disease (GERD) objectively.<sup>1</sup> This system allows us the analysis of the quantified time of esophageal acid exposure, and the association between symptoms and reflux events. It has many advantages in elucidating the reason for failure of proton pump inhibitor (PPI) treatment in patients with reflux symptoms, documenting reflux before and after anti-reflux surgery, and assessing the adequacy of acid control in patients with complicated GERD. Using dual sensor pH catheter, we can also analyze proximal acid reflux to the level of the pharynx.

To measure the esophageal pH, the catheter should be passed trans-nasally, placed with manometric guidance, then taped to the patient's nose, and removed after 24 hours. Absolutely, poor tolerance is the main disadvantage for catheter-based pH monitoring. It is uncomfortable, and induces social embarrassment, and interrupts daily activity during the pH monitoring, which may affect the sensitivity of the test. One study reported

that the patients during the test spent less time being active, were more likely to skip breakfast, and experienced dysphagia more often due to the catheter.<sup>2</sup> Moreover, a number of other disadvantages for catheter-based pH monitoring were noticed as follows. First is the variable sensitivity and specificity.<sup>3-5</sup> Upto 23% of patients with erosive reflux disease showed false negative results. And 5% to 10% studies failed due to malpositioning. Another issue is the low reproducibility. One study showed that 27% of patients showed discordant results in 2 separate day tests.<sup>6</sup> Third, limited duration of examination, only 24 hours, leads to less reproducible and less sensitive results.

Introduction of the catheter-free wireless pH monitoring using a radiotelemetry (433 MHz) pH sensing capsule that is attached to the mucosa of the distal esophagus improved patient tolerability, ability to perform their daily activities and capability of performing extended recording periods of more than 48 hours (2-4 days).<sup>7</sup> In fact, one randomized cross over study comparing symptoms and daily activities between wireless pH and catheter-

Received: March 20, 2012 Revised: None Accepted: March 20, 2012

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Financial support: None.

Conflicts of interest: None.

ter-based pH, revealed less adverse symptoms in wireless pH except chest discomfort or pain, and less interference with daily activities in wireless pH monitoring.<sup>8</sup>

Increasing the recording duration may enhance the sensitivity to detect reflux events. In retrospective analysis of 83 patients undergoing wireless pH monitoring upto 96 hours, Scarpulla noted that prolonged reflux studies increased the diagnostic yield of investigation.<sup>9</sup> In this study, diagnostic yield, sensitivity and specificity were increased in 72 hour results and worst day results increased the sensitivity and diagnostic yield, but decreased the specificity.

Another advantage of wireless pH is availability to study both off and on PPI during 96 hour monitoring. Hirano elegantly demonstrated that although initial esophageal exposure was 15.3% on day 1, after the administration of twice a day PPI, the acid exposure decreased to 1.3% on day 2, 1% on day 3 and 0.5% on day 4.<sup>10</sup>

However, there are some disadvantages of wireless pH monitoring. Technically it cannot differentiate an acid swallow from acid reflux; there is the possibility to overestimate.<sup>7</sup> Also, the low sampling rate may miss short reflux episodes.<sup>11,12</sup> Additionally in 10% of examinations, early detachment induced false low pH levels.<sup>13</sup> In contrast there may be lack of capsule detachment. Other disadvantages are chest pain or discomfort from the pH capsule placement, especially in patients with functional disorders. Sometimes, severe pain may require endoscopic removal in under 2% of patients. Esophageal injury and rare life-threatening perforation were reported. And capsule placement may induce hypertensive esophageal contractions, which provoke chest pain or discomfort. Cost of endoscopy will be added to the cost of pH monitoring. Finally it cannot monitor the proximal esophagus and stomach.

The studies comparing catheter-based to wireless capsule-based monitoring for GERD have shown that the capsule-based system may tend to underestimate reflux events.<sup>11,12</sup> The underestimation of wireless capsule pH may come from a lower sampling frequency (obtains data every 6 seconds) compared with catheter based pH system (every 4 seconds), and overestimation of catheter pH because the catheter entered the "acid pocket" during the transient lower esophageal sphincter relaxation with brief esophageal contraction and shortening.<sup>14</sup>

Another recently developed system for reflux monitoring is impedance-pH testing. There are many theoretical potential advantages. It is the most sensitive technique for detecting all forms of reflux. It can detect all bolus movement, all types of re-

flux, and can also detect the nature of refluxate. Additionally it can detect esophageal volume clearance after reflux and proximal extent. Finally, it can increase yield of symptom association analysis both in patients off and on PPI therapy.<sup>15-17</sup> The main drawbacks of impedance pH monitoring are still catheter problems, and time consuming analysis using manual correction.<sup>18</sup> A recent study using on therapy impedance-pH compared with off therapy wireless pH in refractory GERD, suggested abnormal impedance-pH in patients on therapy predicted acid reflux of wireless pH in patients off therapy.<sup>19</sup>

In this issue of *Journal of Neurogastroenterology and Motility*, Karamanolis et al<sup>20</sup> proved again that extended reflux studies improved the detection of reflux and increased the sensitivity of testing.<sup>20</sup> They found an additional 12.1% gain in pathological esophageal acid exposure and an additional 12.5% gain in positive symptom index after 2 days in 32 patients with non-cardiac chest pain (NCCP). They also found that 90% (18) of patients with objective GERD by wireless pH experienced moderate or marked symptom improvement compared with only 16.7% (2) improvement in patients without GERD evidence. In patients with NCCP, the pooled sensitivity, specificity, and diagnostic odds ratio for the PPI test versus 24-hour pH monitoring and endoscopy were 80%, 74% and 13.83 (95% CI, 5.48-34.91), respectively.<sup>21</sup> Interestingly, in this study, the sensitivity, specificity, positive predictive value, and negative predictive value for double dose PPI trial for 4 weeks versus 2-day wireless pH monitoring were 90% (18/20), 83% (10/12), 90% (18/20) and 83% (10/12), respectively (Table).<sup>21</sup> This improvement of diagnostic yield for PPI trial compared with previous studies suggests that more correlated results to acid reflux could be obtained from wireless pH monitoring. Otherwise, PPI test is a very useful diagnostic method for patients with NCCP. Further studies for wireless pH in patients with extra-esophageal syndromes will be needed.

In conclusion, both catheter-based and wireless pH monitor-

**Table.** Results of Wireless pH Monitoring and Response to Proton Pump Inhibitor Trial

PPI response	Wireless pH monitoring		Total (N = 32)
	GERD (n = 20)	Non-GERD (n = 12)	
Positive	18	2	20
Negative	2	10	12
Total	20	12	32

PPI, proton pump inhibitor; GERD, gastroesophageal reflux disease.

ing are acceptable for distal esophageal monitoring. For refractory GERD, on PPI impedance pH monitoring may be the single best strategy for evaluation of reflux symptoms. For a more tolerable prolonged study, wireless pH monitoring will be the best system known so far.

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