Research Article

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High resolution esophageal pressure topography (HREPT) in asymptomatic volunteers. a comparative study between solid-state and water-perfused systems

Abstract

Background and aim:

I. HREPT is the most accurate technique for identifying esophageal motility disorders (EMD).

II. The Chicago Classification (CC) emerged to diagnose EMD. The CC parameters were obtained using a solid-state high resolution manometry (HRM) system.

III. There are few studies comparing HREPT metrics between a solid-state versus water-perfused systems. Aim: To compare the HREPT metrics between both systems in healthy volunteers (HV)

Patients and methods:

I. Observational, transversal, crossover and comparative study.

II. HV underwent two HRM: solid-state and water perfused systems. HV were randomized for the first HRM and one week later the other system. One HRM was performed using a solid-state catheter with 36 pressure sensors and Manoview 2.0 analysis program. Another HRM was performed using a water-perfusion catheter with 22 channels and database Inc. MMS program.

III. Ten liquid swallows with 5 cc of water were administered. UES pressure, distal contractile integral (DCI), distal latency (DL), LES basal pressure and integrated relaxation pressure (IRP) were analyzed.

IV. Statistical analysis was made with STATA version 11. Non-parametric statistics were used to summarize the data and for comparison between the 2 HRM systems.

Results: Twenty HV were included, 14 women, mean age 34 (24-55) years. The pressures in the UES and LES pressures, IRP are lower with the perfusion system (p 0.0064, 0.008 and 0.0061, respectively) and have a faster peristalsis registration with the solid system, (DL p 0.0002). With the CC 2012, the solid state system presented a higher frequency of volunteers with hypotensive peristalsis (p 0.0143).

Conclusion: HREPT metrics: UESp, LESp and IRP were significantly lower when the HRM was performed with the water-perfused system. These findings must be considered when CC is used to classify EMD with HRM water-perfused system.

Keywords: High-resolution manometry; Chicago Classification; Hypotensive peristalsis; Lower esophageal sphincter; Esophageal peristalsis

Volume 2 Issue 2 - 2015

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Received: January 20, 2015 | **Published:** April 6, 2015

Abbreviations: HREPT, high resolution esophageal pressure topography; EMD, esophageal motility disorders; CC, chicago classification; Hv, healthy volunteers; IRP, integrated relaxation pressure; DCI, distal contractile integral

Background and aims

The High Resolution Esophageal Pressure Topography (HREPT) has positioned as the most accurate technique for identifying esophageal motility disorders (EMD). Esophageal high resolution manometry (HRM) has dramatically changed the information obtained, diagnosis and knowledge of new pathologies. There are two different systems to perform HRM: the solid-state system and the water-perfused system. These systems have different structural and dynamic mechanisms to obtain HREPT. They do not need the pull-through techniques as the motility of the esophagus and the situation of the sphincters can be recorded at the same time.

There are two types of HRM catheters; the pressures registrated by each one are converted to electrical signals and then processed by software.[1,2] The solid-state catheter has a diameter of 4.2 mm. It consists of 36 copper sensors, separated by 1 cm each one. Each sensor has 12 sensors integrated at the circumference; this means that each sensor performs a circumferential registration from the 35 spaced segments from the hypopharynx to the stomach[3–7] Figure 1(A). The dynamic response is high due to the sensors situated in each segment.[5] The water-perfused catheter is a polyvinyl (silicone) tube, consisting of sided holes along it (22-36 holes) with different distribution, with more holes at the distal part. Each hole acts as point pressure sensors connected to different channels that finally are connected to external transducers. They sense in only one direction[5–7] Figure 2(A). The solid-state system is easy to calibrate, but it is expensive, it is not comfortable for the majority of the patients and it is vulnerable to damage.[5,6] The information provided by the catheter varies with temperature, so temperature compensation must then be performed[5] Figure 1(B). It is important to comment that the pressure registrations occur inside the patient, directly in the esophagus.

Figure 1A & 1B in the same volunteer. HREPT with representative: UES, IRP, LES and DCI metrics.

The water-perfused system requires a pneumohydraulic pump to perform the perfusion. The pressure detected in each hole of the catheter is registered by external transducers.[5,7] This system requires more time for the calibration, it is not as expensive as the solid-state catheter and the material is more flexible and comfortable to the patient[5,6] Figure 2(B). The pressure registrations are processed at the transducers, outside the esophagus. Both the software used to analyze pressure data have the application of color contours to represent the intraluminal pressure.[1,2] The Chicago Classification (CC) has been proposed to diagnose EMD. The CC parameters were obtained using a solid-state HRM system.[3,6–8,9] The CC had presented several modifications through the years and new diagnosis proposals are emerging. Otherwise, the normative values and measures can also be made with MMS analysis software.[1,2,6] The isobaric contour (IC) is a tool in both HRM, that allows know the pressure surrounded by a black line (Given Imaging) or in different colors (MMS) of the topography plots for an assigned pressure. There are few studies comparing HREPT metrics between solid-state versus water-perfused systems. The aims of this study were to compare the HREPT metrics between solid-state and water-perfused systems in healthy volunteers (HV) and the Chicago Classification 2012 between both systems.

Figure 2A & 2B in the same volunteer. HREPT with representative: UES, IRP, LES and DCI metrics.

Methods

This was an observational, transversal and comparative study.

PATIENTS

We included healthy volunteers of the gastrointestinal tract between 18 and 60 years old, without history of gastrointestinal surgery that agreed to be enrolled in the study. They were excluded if any condition known to impair esophageal motility was present (scleroderma, diabetes mellitus).

HRM

HV underwent 2 HRM, previous randomization for the first system performed, with interval of one week between each one. The catheters were passed trasnasally, allowing the recording of the hypopharynx to the stomach with at least 3 intragastric sensors. The HRM were performed using a solid state catheter with 36 pressure sensors and Manoview 2.0 analysis program and with a water-perfused catheter with 22 channels and database Inc. MMS program.

All subjects underwent HRM after a 6 h fasting period, in supine position. In each manometry study, ten liquid swallows with 5 cc of water every 30 seconds were administered. UES basal pressure, distal contractile integral (DCI), amplitude, contractile front velocity (CFV), proximal border of the LES localization, LES length, LES basal pressure and integrated relaxation pressure (IRP) were analyzed. The esophageal body contraction was evaluated with Chicago Classification 2012 criteria.[9,10] Statistical analysis was made with STATA version 11.0. Non-parametric statistics were used to summarize the data and Wilcoxon signed-rank test was used for comparison between both HRM systems. For the analysis, the solid-state system was labeled as Group 1 and water-perfused system as Group 2. The statistical was blinded about which system was used in each group.

Ethical considerations

The protocol for the research project had been approved by the Scientific and Ethic Committee of the Instituto Nacional de Ciencias Médicas y Nutricion Salvador Zubiran and it conforms to the provisions of the Declaration of Helsinki.

Results

Twenty HV were included, 14 women (70%), mean age 34 (24-55) years. The HREPT metrics with the solid-state and water-perfused systems are depicted in (Table 1). UES pressure, LES pressure and IRP were significantly lower when the HRM was performed with the water-perfused system. DL is significantly faster in the solid system. Samples of the images provided by each system are depicted in Figure 1(A&1B) and Figure 2(A&2B). In the analysis of the peristalsis contraction for these metrics and the peristaltic integrity (with an IC of 20 mmHg) in the studies performed, in the solid-state system 12 (60%) HV were classified as normal and 8 subjects (40%) as weak peristalsis (including those with small and large breaks, frequent failed peristalsis); in the other hand, in the studies performed with water-perfused system 18 subjects (90%) were classified as normal and 2 (10%) as weak peristalsis (p 0.0143). Other EMD were not found in these volunteers. There are no differences in the LES localization and other esophageal body parameters but there was statistic significance in the IC for delimitating the presence/absence of small/large breaks for the weak peristalsis criteria.

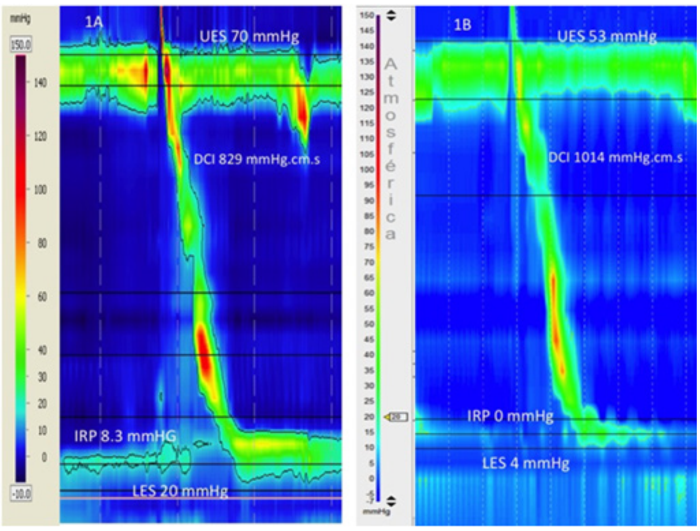
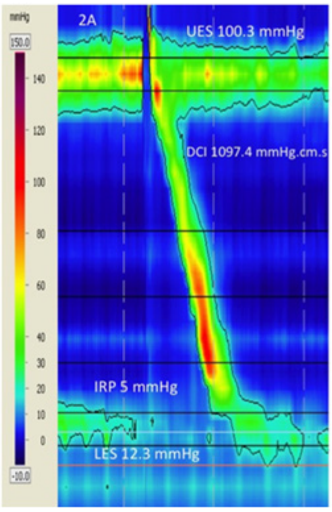


Figure 1A Image of solid-state system.

Figure 1B Image of water-perfused system.

Citation: Monica ZS, Elisa SC, Enrique CA, et al. High resolution esophageal pressure topography (HREPT) in asymptomatic volunteers. a comparative study between solid-state and water-perfused systems. *Gastroenterol Hepatol Open Access.* 2015;2(2):39–43. DOI: 10.15406/ghoa.2015.02.00033



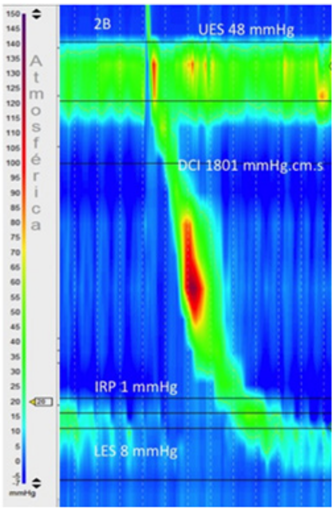


Figure 2A Image of solid-state system.

Figure 2B Image of water-perfused system.

Conclusion

HREPT metrics: UES pressure, LES pressure and IRP were significantly lower when the HRM was performed with the water-perfused system. DL is significantly faster in the solid system. These findings must be considered when the CC is used to classify EMD with HRM water-perfused system.

Discussion

Over the last decade, HRM has emerged as the gold standard for identifying EMD. Since Clouse et al described the initial findings with this technology; HRM has been an area of interest and searching of several groups. The Chicago Classification emerged as an evolutionary process, with the intention to unify diagnostic criteria, facilitate the interpretation and summarize the knowledge of the esophageal pressure topography for the clinical practice.[8] All the studies derived from this classification were performed with solid-state HRM. The systems used worldwide are based in water-perfused system and solid-state system, with the advantages and disadvantages that we had commented. In our center, we have both systems. This study emerged as the inquietude to know if the Chicago Classification parameters were adaptable to the high-resolution perfusion system. The real advance and benefit with these systems are the analysis techniques provided by the HRM software that creates de Esophageal pressure Topography; but we have to consider the different dynamic mechanisms and material of each catheter for the registration of the esophageal information used by the HRM systems. The clinical significance of unidirectional versus circumferential pressure registration has been demonstrated, especially in the structures characterized by an irregular anatomy where the unidirectional sensor point influences the measure (UES, LES) where the pressure obtained was significantly impaired with the water-perfused system.

Table 1 HREPT metrics with the solid-state and water-perfused systems. All measures are shown as median (ranges)

Variable	Solid - state system n=20	Water-perfused system n=20	P
LES pressure (mmHg)	22.2 (2.4-44.6)	12 (2-27)	0.008*
IRP (mmHg)	6 (0-14.8)	0.4 (0-14.1)	0.0061*
LES Proximal Border (cm)	40.4 (36.8-46.1)	39.85 (34.4-47.6)	0.6274
LES length (cm)	3.05(2.1-4.3)	2.85 (1.7-4.2)	0.455
Amplitude (mmHg)	75.9 (31.4-144.2)	66(28-122)	0.1003
DCI (mmHg.cm.seg)	851.15 (70.9-2631)	1118.7 (40-3133.9)	0.2959
DL (s)	5.97 (4.7-7.6)	7.12 (5.7-8.9)	0.0002*
CFV (cm/s)	3.65 (1.7-5.9)	3.025 (2.08-3.93)	0.0522
UES pressure (mmHg)	65.35 (11.9-116.9)	25.5 (1-115)	0.0064*

*p<0.05

LES, lower esophageal sphincter; IRP, integrated relaxation pressure; DCI, distal contractile integral; DI, distal latency; UES, upper esophageal sphincter

Our results show significantly faster peristalsis propagation with the solid system, expressed by the DL. This may be due to the distance between the sensors in each catheter too, but also as a result of the material and registration of each system. The metal has a faster transmission of the pressure signals directly sensored inside the esophagus than the perfusion water holes that send the pressure signal to external transducers. The CC has proposed to start the evaluation of the HREPT with the GEJ relaxation.[3,8] Our results strongly suggest that the IRP values are significantly lower with the water-perfused system, so a patient can wrongly be characterized since this first step according to this measure. In the esophageal body parameters, there were no differences between the amplitude pressure and DCI. May be this is due to the uniform size and shape of S2 and S3 segments of the esophageal body, so the circumferential or unidirectional registration are not significantly altered. The IC, used to define the presence or absence of breaks, was performed in each swallow. The presence of hypotensive peristalsis was the main EMD in this volunteers with the solid-state system and the frequency is similar to the reported the HV in Chicago Classification. With the water-perfusion system, HV had an increase frequency of normal peristalsis. The clinical significance of the differences in hypotensive vs normal peristalsis between both systems in patients is not known.

The main limitation of our study is the sample size; but the results clearly demonstrate significant differences in the metrics between both HRM systems in UES pressure, LES pressure and IRP. The

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studies were not done at the same day, because the need of fasting to perform the study and introduce the catheter, but this bias was handled with the randomization for performing the first HRM. The principal fortress of the study is that the volunteers were their own control, diminishing the selection criteria. The studies were performed with the same machines, in the same country and center diminishing demographic variables and were performed by expert physicians in the area. This study strongly demonstrates that a classification with HRM and normative metrics values are required for the evaluation of HREPT performed with water-perfused system.

Acknowledgments

In memorial: To Florencia Vargas Vorackova who participated in planning the analysis of this work. This study was presented in part at the DDW (San Diego, May 2012) Poster ID: Sa1191.

Specific author contributions: Monica Zavala-Solares: performance of manometries, analysis and interpretation of data, and drafting of manuscript; Miguel Angel Valdovinos: study concept and design, interpretation of data, and drafting of manuscript; Elisa Saleme-Cruz: Schedule of manometries, collection of data; Lourdes Pinzon-Te: collection of data, Enrique Coss-Adame: drafting of manuscript.

Conflicts of interest

This work was not supported by grants. MA Valdovinos has served as speaker and consultant for Given Imaging, Takeda and Danone.

References

1. Freeman C, Berg JW, Cutler SJ. Occurrence and prognosis of extranodal lymphomas. *Cancer*. 1972;29(1):252–260.
2. Swerdlow SH, Campo E, Harris NL, et al. *WHO classification of tumours of haematopoetic and lymphoid tissues*. (4th edn), IARC Press, USA, 2008. p. 439.
3. Wotherspoon A, Ortiz-Hidalgo C, Falzon MR, et al. Helicobacter pylori associated gastritis and primary B-cell lymphoma. *Lancet*. 1991;338(8776):1175–1176.
4. Chan JK, Ng CS, Isaacson PG. Relationship between high-grade lymphoma and low-grade B-cell mucosa associated lymphoid tissue lymphoma of the stomach. *Am J Pathol*. 1990;136(5):1153–1164.
5. Eck M, Schmausser B, Haas R, et al. MALT-type lymphoma of the stomach is associated with Helicobacter pylori strains expressing the CagA protein. *Gastroenterology*. 1997;112(5):1482–1486.
6. Wotherspoon AC, Doglioni C, Diss TC, et al. Regression of primary low-grade B-cell gastric lymphoma of mucosa-associated lymphoid tissue. *Lancet*. 1993;342(8871):575–577.
7. Fischbach W. *Best Practice & Research Clinical Gastroenterology*. 2014;28:1069–1077.
8. Malfertheiner P, Megraud F, O'Morain CA. Management of Helicobacter pylori infection -the Maastricht IV/ Florence Consensus Report. *Gut*. 2012;61:646.
9. Dawson I, Cornes J, Morson B. Primary malignant lymphoid tumours of the intestinal tract. Report of 37 cases with a study of factors influencing prognosis. *Br J Surg*. 1961;49:80–89.
10. Shiozawa E, Norose T, Kaneko K, et al. Clinicopathological comparison of the World Health Organization/Wotherspoon score to the Groupe d'Etude des Lymphomes de l'Adult grade for the post-treatment evaluation of gastric mucosa-associated lymphoid tissue lymphoma. *J Gastroenterol Hepatol*. 2009;24(2):307–315.
11. Koch P, del Valle F, Berdel WE, et al. Primary gastrointestinal non-Hodgkin's lymphoma: I. Anatomic and histologic distribution, clinical features, and survival data of 371 patients registered in the German Multicenter Study GIT NHL 01/92. *J Clin Oncol*. 1991;19(18):3861–3873.
12. Cogliatti SB, Schmid U, Schumacher U, et al. Primary B-cell gastric lymphoma: a clinicopathological study of 145 patients. *Gastroenterology*. 1991;101(5):1159–1170.
13. Kolve M, Fischbach W, Greiner A, et al. Differences in endoscopic and clinicopathological features of primary and secondary gastric non-Hodgkin's lymphoma. *Gastrointest Endosc.* 1999;49(3):307–315.
14. Muller AF, Maloney A, Jenkins D, et al. Primary gastric lymphoma in clinical practice 1973-1992. *Gut*. 1995;36(5):679–683.
15. Wang T, Gui W, Shen Q. Primary gastrointestinal non-Hodgkin's lymphoma: clinicopathological and prognostic analysis. *Med Oncol*. 2010;27(3):661–683.
16. Radaszkiewicz Th, Dragosics B, Bauer P. Gastrointestinal malignant lymphomas of the mucosa-associated lymphoid tissue. Factors relevant to prognosis. *Gastroenterology*. 1992;102(5):1628–1638.
17. Stolte M. Helicobacter pylori gastritis and gastric MALT-lymphoma. *Gut*. 1992;50(S3):11119–11124.
18. Morgner A, Lehn N, Andersen LP, et al. Helicobacter heilmannii-associated primary gastric low-grade MALT lymphoma: complete remission after curing the infection. *Gastroenterology.* 2000;118(5):821–828.
19. Zucca E, Bertoni F, Roggero E, et al. Molecular analysis of the progression from Helicobacter pylori-associated chronic gastritis to mucosa-associated lymphoid-tissue lymphoma of the stomach. *N Engl J Med*. 1998;338(12):804–810.
20. Akamatsu T, Mochizuki T, Okiyama Y, et al. Comparison of localized gastric mucosa-associated lymphoid tissue (MALT) lymphoma with and without Helicobacter pylori infection. *Helicobacter*. 2006;11(2):86–95.
21. Ruskon FA, Fischbach W, Aleman BMP, eet al. EGILS consensus report. Gastric extranodal marginal zone B cell lymphoma of MALT. *Gut*. 2011;60(6):747–758.
22. Fischbach W, Al-Taie O. Staging role of EUS. *Best Pract Res Clin Gastroenterol*. 2010;24(1):13–17.
23. Rohatiner A, d'Amore F, Coiffier B, et al. Report on a workshop convened to discuss the pathological and staging classifications of gastrointestinal tract lymphoma. *Ann Oncol*. 1994;5(5):397–400.
24. Wündisch T, Thiede C, Morgner A, et al. Long-term follow-up of gastric MALT lymphoma after Helicobacter pylori eradication. *J Clin Oncol*. 2005;23(31):8018–8024.
25. Stathis A, Chini C, Bertoni F, et al. Long-term outcome following Helicobacter pylori eradication in a retrospective study of 105 patients with localized gastric marginal zone B-cell lymphoma of MALT type. *Ann Oncol*. 2009;20(6):1086–1093.
26. Nakamura S, Sugiyama T, Matsumoto T, et al. Long-term clinical outcome of gastric MALT lymphoma after eradication of Helicobacter pylori: a multicentre cohort follow-up study of 420 patients in Japan. *Gut.* 2012;61(4):507–513.
27. Tomita N, Kodaira T, Tachibana H, et al. Favorable outcomes of radiotherapy for early-stage mucosa-associated lymphoid tissue lymphoma. *Radiother Oncol*. 2009;90(2):231–235.
28. Zucca E, Copie-Bergman C, Ricardi U, et al. Gastric marginal zone lymphoma of MALT type: ESMO clinical recommendations for diagnosis, treatment and follow-up. *Ann Oncol Suppl*. 2008;6:144–148.

29. Liu H, Ye H, Ruskone-Fourmestraux A, et al. T(11;18) is a marker for all stage gastric MALTlymphomas that will not respond to H. pylori eradication. *Gastroenterology*. 2002;122(5):1286–1294.

30. Martinelli G, Laszlo D, Ferreri AJ, et al. Clinical activity of rituximab in gastric marginal zone non-Hodgkin's lymphoma resistant to or not eligible for anti-Helicobacter pylori therapy. *J Clin Oncol*. 2005;23(9):1979–1983.

31. Conconi A, Martinelli G, Thiéblemont C, et al. Clinical activity of rituximab in extranodal marginal zone B-cell lymphoma of MALT type. *Blood*. 2003;102(8):2741–2745.

32. Olszewski AJ, Castillo JJ. Comparative outcomes of oncologic therapy in gastric extranodal marginal zone (MALT) lymphoma: analysis of the SEER-Medicare database. *Ann Oncol*. 2013;24(5):1352–1359.

33. Zullo A, Hassan C, Ridola L, et al. Eradication therapy in Helicobacter pylori-negative,gastric low-grade mucosa-associated lymphoid tissue lymphoma patients. A systematic review. *J Clin Gastroenterol.* 2013;47(10):824–827.

34. Levy M, Copie-Bergman C, Traulle C, et al. Groupe d'Etude des Lymphomes de l'Adulte (GELA). Conservative treatment of primary gastric low-grade B-cell lymphoma of mucosa-associated lymphoid tissue: predictive factors of response and outcome. *Am J Gastroenterol*. 2002;97(2):292–297.

35. Angelo Zullo, Cesare Hassan, Lorenzo Ridola, et al. Gastric MALT lymphoma: old and new insights. *Ann Gastroenterol*. 2014;27(1): 27–33.