HIGH RESOLUTION AND HIGH DEFINITION ANORECTAL MANOMETRY:

USEFULNESS, LIMITATIONS, WHEN AND WHY

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DISCLOSURE: José María Remes-Troche

José-María Remes-Troche has served on the Advisory Board of Allergan, Carnot and Sanfer.

He has been a consultant for Alfa-Wasserman, Almirall, Commonwealth Laboratories Inc, Takeda Mexico, Asofaroma Mexico and Sanfer.

He has also been a speaker for Alfa Wasserman, Takeda Mexico, Carnot, Sanfer and Almirall.

He has received grant supports from Alfa Wasserman and Sanfer.
AIM

✓ To review and analyze
  ✓ Indications
  ✓ Limitations
  ✓ Clinical utility

HRAM

3-D HDAM
Pelvic Floor Structure
- Ultrasound (2-3D)
- MRI
- Dephecography
- Barium proctogram
- Endoscopy

Motor Function
- Anorectal Manometry
  - Conventional
  - HRAM
  - 3-D HDAM
- Colonic manometry
- EMG

Colonic Transit Time
- Breath test
- Radiopaque markers
- Smart pill
- Gammagrapy
- RFITransit

Neuro Sensory Function
- PNL
- TL and TSMS
- Barostat
- EndoFLIP
- EMG
- CEP
Pelvic Floor Structure

- Ultrasound (2-3D)
- MRI
- Dephecography
- Barium proctogram
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Colonic Transit Time

- Breath test
- Radiopaque markers
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Motor Function

- Anorectal Manometry
  - Conventional
  - HRAM
  - 3-D HDAM
- Colonic manometry
- EMG

Neuro Sensory Function

- PNL
- TL and TSMS
- Barostat
- EndoFLIP
- EMG
- CEP
Why ARM is important?

- Physiological evaluation of the two main functions of the anorectum:
  - Preservation of continence and regulation of defecation.

1. Fecal incontinence
2. Constipation/ evacuatory dysfunction.
2. Facilitate biofeedback training.
2. Assess patients before intervention (e.g., as a prognostic indicator of continence prior to surgical pouch construction);
2. Objectively assess therapeutic efficacy.

Dinning P, Carrington E, Scott MS. Neurogastro and Motil 2015
What is HR-ARM and 3-D HD-ARM
Functional morphology of anal sphincter complex unveiled by high definition anal manometry and three dimensional ultrasound imaging

V. RAIZADA, V. BHARGAVA, A. KARSTEN & R. K. MITTAL

1. A high degree of asymmetry both axially and circumferentially

1. A more inferior position of the sphincter in the anterior compared to the posterior midline

1. The greatest contribution during squeeze was from the distal anterior canal (PR)

1. During squeeze, the posterior peak pressure in the anal canal moves cranially in relation to the anterior peak pressure.
Limitations of ARM

- Lack of uniformity regarding equipment
- Lack of standardization in protocol
- Lack of normal values
- What is normal?
- What is dissynergia?
- Metrics developed in conventional are not for HR and 3-D HD
- Costs, fragility
- **Clinical utility?**
Limitations of ARM

- Lack of uniformity regarding equipment
- Lack of standardization in protocols
- Lack of normal values
- What is normal?
- What is dysynergia?
- Metrics developed in conventional are not for HR and 3-D HD
- Clinical utility?
Methods of anorectal manometry vary widely in clinical practice: Results from an international survey


125 surveys, 30 different countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Frequency (%)</th>
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<tbody>
<tr>
<td>United Kingdom</td>
<td>29 (27.1)</td>
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<tr>
<td>United States</td>
<td>15 (14)</td>
</tr>
<tr>
<td>Mexico</td>
<td>11 (10.3)</td>
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<tr>
<td>Germany</td>
<td>8 (7.5)</td>
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<tr>
<td>Italy</td>
<td>5 (4.7)</td>
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<tr>
<td>Switzerland</td>
<td>5 (4.7)</td>
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<tr>
<td>Australia</td>
<td>4 (3.7)</td>
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<tr>
<td>Argentina</td>
<td>3 (2.8)</td>
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<td>Chile</td>
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<tr>
<td>Ireland</td>
<td>2 (1.9)</td>
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<tr>
<td>Korea, Republic of</td>
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<td>Malaysia</td>
<td>2 (1.9)</td>
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<tr>
<td>Spain</td>
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<tr>
<td>Colombia</td>
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<td>Costa Rica</td>
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<td>Ecuador</td>
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<td>Guatemala</td>
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<td>India</td>
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<td>Turkey</td>
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<tr>
<td>United Arab Emirates</td>
<td>1 (0.9)</td>
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Total: 107 (100)
**FIGURE 1** Comparative pie charts displaying differences in the use of water-perfused and solid-state manometry hardware used between centers performing conventional ARM and HR-ARM.
This study confirms the long-held impression that striking variation exists in the current practice of ARM. Differences between institutions exist in study indications, equipment used, manometry technique, data acquisition, analysis, and reporting. No center responding to this survey fully complies with previously published and widely cited “minimum standards” for ARM.\textsuperscript{4} In particular, there is dissimilarity in the parameters used to report results, a factor that makes accurate comparisons between institutions and further development of the technique challenging.

<table>
<thead>
<tr>
<th>Position</th>
<th>Responses</th>
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<tbody>
<tr>
<td>Supine</td>
<td>5 (5)</td>
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<tr>
<td>Left Lateral</td>
<td>81 (76)</td>
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<tr>
<td>Sitting on a commode</td>
<td>11 (10)</td>
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<tr>
<td>Other</td>
<td>1 (1)</td>
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To develop and **promote internationally accepted standards** for the clinical measurement of anorectal physiology, with a particular focus on HR-ARM.
Limitations of ARM

- Lack of uniformity regarding equipment
- Lack of standardization in protocols
- Lack of normal values, reproducibility?
- What is normal?
- What is dissynergia?
- Metrics developed in conventional are not for HR and 3-D HD
- Clinical utility?
High-Resolution Manometry in the Evaluation

Tu1321

High Resolution Anorectal Manometry: Establishment of Normal Values in Healthy Volunteers

Published in final edited form as:

NORMAL VALUES FOR HIGH-RESOLUTION ANORECTAL
Neurogastroenterol Motil [2014] 26, 529–537
doi: 10.1111/nmo.12297

Neurogastroenterol Motil [2014] 26, 625–635
doi: 10.1111/nmo.12307

Traditional measures of normal anal sphincter function using high-resolution anorectal manometry (HRAM) in 115 healthy volunteers

E. V. CARRINGTON, *, †, ‡, A. BROKJÆR, *, †, ‡, H. CRAVEN, *, N. ZARATE, *, E. J. HORROCKS, *, † S. PALIT, † W. JACKSON, § G. S. DUTHIE, § C. H. KNOWLES, *, † P. J. LUNNISS & S. M. SCOTT *, †
REVIEW ARTICLE

The use of colonic and anorectal high-resolution manometry and its place in clinical work and in research

P. G. DINNING, * E. V. CARRINGTON† & S. M. SCOTT†

Table 1 Normative ranges for measures of anorectal function using HRAM or 3D-HDAM

<table>
<thead>
<tr>
<th>Authors</th>
<th>Year</th>
<th>M</th>
<th>F</th>
<th>Resting tone (mmHg)</th>
<th>Squeeze pressure (mmHg)</th>
<th>Simulated defecation</th>
<th>Rectoanal gradient</th>
<th>% anal relaxation</th>
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<td></td>
<td>M</td>
<td>F</td>
<td></td>
<td>M</td>
</tr>
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</table>

*Women <50; †Women >50; ‡Data expressed as mean (SEM); ††Data expressed as maximum absolute squeeze pressure; †‡Data expressed as median (IQR); †‖Male and female data reported together; †‖Data expressed as mean (95% CI). n.r., not reported.
Three-dimensional high-resolution anorectal manometry in the diagnosis of paradoxical puborectalis syndrome compared with healthy adults: a retrospective study in 79 cases

3D High-definition anorectal manometry: Values obtained in asymptomatic volunteers, fecal incontinence and chronic constipation. Results of a prospective multicenter study (NOMAD)

F. Mion | A. Garros | C. Brochard | V. Vitton | A. Ropert | M. Bouvier | H. Damon | L. Siproudhis | S. Roman

Accuracy and Reproducibility of High-definition Anorectal Manometry and Pressure Topography Analyses in Healthy Subjects

Enrique Coss-Adame,* Satish S. C. Rao,‡ Jessica Valestin,‡ Amyra Ali-Azamar,§ and Jose M. Remes-Troche§

*Digestive Health Center, Georgia Regents University, Augusta, Georgia; ‡University of Iowa Hospitals and Clinics, Iowa City, Iowa, and §Biological and Medical Research Institute, University of Veracruz, Veracruz, Mexico
Values from 3-dimensional High-Resolution Anorectal Manometry Analysis of Children Without Lower Gastrointestinal Symptoms

Marcin Banasiuk, Aleksandra Banaszkiewicz, Marcin Dziekiewicz, Andrzej Załęski, Piotr Albrecht
Reproducibility of high-definition (3D) manometry and its agreement with high-resolution (2D) manometry in women with fecal incontinence

Conclusions & Inferences: Among women with fecal incontinence, measurements with HD-ARM were reproducible on the same (anal resting and squeeze pressures and recto-anal gradient during evacuation) and different days (anal resting and squeeze pressures) and correlated with HR-ARM measurements. These findings support use of HD-ARM and HR-ARM for longitudinal assessments of anal resting and squeeze pressures.
Limitations of ARM

- Lack of uniformity regarding equipment
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- Lack of normal values
- What is normal?
- What is dissynergia?
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- Clinical utility?
Investigation of the utility of colorectal function tests and Rome II criteria in dyssynergic defecation (Anismus)

S. S. C. Rao, R. S. Mudipalli, M. Stessman & B. Zimmerman

100 FC Rome II
(80 Female)

Manometric Patterns: Attempted Defecation

Type I

Type II

Normal

Type III

Type IV

How might it impact on clinical practice in the foreseeable future?

These findings suggest that high-resolution AM is of limited accuracy for discriminating between healthy people and patients with FC. The role of AM for diagnosing FDD merits further study.
Three traditional parameters unlikely to have diagnostic utility because wide variations in health

• Rectal push pressure
• Anal residual pressure
• Endurance of squeeze

Recto anal gradient
Defecation index
Seated Evaluation of Anorectal Function By High Resolution Manometry: A Randomized Comparison of Measurements in the Seated and Left Lateral Positions.

HR-ARM and BET is affected by position, especially in DD patients. Comparison of HR-ARM with MRD suggests more accurate assessment of simulated defecation in the physiologic SP.

A Characterization of Dyssynergia Phenotypes With High Resolution Anorectal Manometry (HRAM).

174 DD patients

1. Dyssynergia in 2 positions
   - Dyssynergia pattern 85%
   - Normalize 27%
   - Dyssynergia pattern 65%

1. Interobserver agreement
   - Kappa 0.8

Phenotypic Identification and Classification of Functional Defecatory Disorders Using High-Resolution Anorectal Manometry

SHIVA K. RATUAPLI\textsuperscript{1,2}, ADIL E. BHARUCHA\textsuperscript{1,2}, JESSICA NOELTING\textsuperscript{3}, DORIS M. HARVEY\textsuperscript{2,4}, and ALAN R. ZINSMEISTER\textsuperscript{5}

62 HV Female

295 Female with CC

Normal
\( n = 60 \)

Abnormal
\( n = 2 \)

Normal
\( n = 224 \)

Abnormal
\( n = 71 \)
Proposed Phenotypes

- Excessive straining against high ARP: 6%
- Rectal sensorimotor dysfunction: 11%
- Unclear?: 5%
- Inappropriate Abdominal contraction: 13%

Anal blockage

Present in CC
Normal BET
A Characterization of Dyssynergia Phenotypes With High Resolution Anorectal Manometry (HRAM).

D = Diffuse  P = Puborectal  A = Anal sphincter

10%
Pitfalls for ARM

• Lack of uniformity regarding equipment
• Lack of standardization in protocols

Minimal standards. Rao et al. 2002

• Lack of normal values
• What is normal? What is dissynergia?

• **Metrics developed in conventional are not for HRM-3D HRM**
• Clinical utility?
New parameters, New analysis for HRAM?

Post-relaxation cough reflex
Carrington E et al. 2014

IPV ratio
Mion et al. 2017

Positive gradient and High band pressure
Heinrich H et al. 2014

Phenotypic classification
Ratuapli et al. 2014

Novel parameters
Remes-Troche et al. DDW 2013

Integrated pressurized volume (IPV)
Jung KE et al. 2014
Pitfalls for ARM

- Lack of uniformity regarding equipment
- Lack of standardization in protocols
  Minimal standards. Rao et al. 2002
- Lack of normal values
  What is normal? What is dysynergia?
- Metrics developed in conventional are not for HRM-3D HRM
- Clinical utility?
Clinical Utility

1. Color contour/ topography plots provide a dynamic and continuous representation of anorectal pressure information, which is both more visually arresting and intuitive compared to traditional line plots.

1. Anal sphincter defects can be mapped and readily detected using 3-D technology.

1. HRAM study is ~12 min quicker than performing a traditional anorectal manometry study.
188 patients with obstructive defecation

87 structural pathology

Lower resting pressure (p<0.003)
Lower squeeze pressure (p<0.011)
Higher rectoanal pressure gradient (p<0.0001)

24 patients with Intra-Anal Intussusception exhibit a unique pattern
High-resolution Rectoanal Manometry for Identifying Defecatory Disorders and Rectal Structural Abnormalities in Women

David O. Prichard, M.B., B.Ch., Ph.D., Taehee Lee, M.D., Ph.D., Gopanandan Parthasarathy, M.B.B.S., Joel G. Fletcher, M.D., Alan R. Zinsmeister, Ph.D., Adil E. Bharucha, M.D

30 HV

118 patients
51 CC, 48 FI, 19 RP
A PC logistic model discriminated between patients with and without prolapse with 96% accuracy.
Rectal intussusception: can high resolution three-dimensional ano-rectal manometry compete with conventional defecography?

A. Benezech¹,² | M. Cappiello³ | K. Baumstarck⁴ | J.-C. Grimaud¹,² | M. Bouvier¹,² | V. Vitton¹,²

Present in 21/26 (80%)
PPV 100%, NPV 100%, S 69.2%
Three-Dimensional Anorectal Manometry Enhances Diagnostic Gain by Detecting Sphincter Defects and Puborectalis Pressure

Shreya Raja¹ · Francis C. Okeke¹ · Ellen M. Stein¹ · Sameer Dhalla¹ · Monica Nandwani³ · Kristle L. Lynch¹ · C. Prakash Gyawati² · John O. Clarke³

Normal

Abnormal
Can 3D high resolution anorectal manometry detect anal sphincter defects in patients with faecal incontinence?


39 patients = 14 (36%) defects with 3D-HDAM

Sensitivity = 75%
Specificity = 74%
PPV = 43%
NPV 92%

any pressure measurement below 25 mmHg with the anal canal at rest, with at least 18° of continuous expansion. The percentage of the anal circumference with a pressure
Prevalence of defects with 3D-HDAM = 22%

Sensitivity = 37.5%
Specificity = 100%
PPV = 100%
NPV 44%
CONCLUSIONS

The greater yield of anatomical and functional information may supersede the limitations of costs, fragility, and shorter life-span associated with these new techniques.

Thus, HDAM and HRAM are not just new gadgets but constitute a significant and novel diagnostic advance.

However, more prospective studies are needed to better define anorectal disorders with these techniques and to confirm their superiority.