Barium 101
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Disclosures

Financial Disclosure:
Clinical Sales Specialist for Dysphagia
Employee of Bracco Diagnostics Inc.

No Non-financial Disclosures

*Presentation will include product discussion.

Learner Outcomes

Participants will be able to:

1. Describe the intended uses of traditional barium preparations for GI radiology, and how they impact the modified barium swallow (MBS) study.
2. State the difference between viscosity and density, and how each is measured.
3. Identify the key information on a barium product label.
4. Name at least 2 differentiating components of the barium preparations that were specifically designed for the MBS.

Our Mission

To provide a contrast agent that helps standardize the assessment of swallowing disorders in dysphagia patients, assisting SLPs to partner with radiologists to ensure a consistent and reliable diagnostic approach.

In the beginning...

When we started to perform systematic imaging tests of the swallowing mechanism:
– We knew we needed viscosities representing:
   • Thin liquid
   • Nectar
   • Honey
   • Puree
   • Solid (cookie or cracker)
– And we knew we had to use barium to see what we needed to see

Barium contrast choices at that time...

We used what was available to create the desired viscosities

*Available choices in the 1980's
*See Indications and Important Safety Information on slides 43 and 44
What we later considered...

Inter-user and Intra-user reliability
- Variability of barium preparations selected
- Variability of recipes used to make each viscosity for testing
- Subjectivity and perception
- Evidence-based practice

Unique Properties of Barium Preparations
- Density (weight/volume [w/v])
- Viscosity (resistance to flow)
- Coating ability to adhere to the mucosal lining of the GI tract

Intended Purpose of Traditional Barium Preparations
- Designed to fill and/or coat
- Designed for specific procedures

What is Barium?

Barium is a chemical element, atomic number 56, atomic weight 137.40, symbol Ba

- Barium sulfate (BaSO₄), a common barium compound, is used as a filler for rubber, plastics and resins
- BaSO₄, when swallowed, can be used to visualize the GI tract because of the ability of the barium atoms to block X-rays

Other Barium Compounds

- Barium carbonate (BaCO₃) is used in the manufacture of ceramics and some types of glass
- Barium nitrate (Ba(NO₃)₂) burns with a bright green color and is used in signal flares and fireworks
- Barium chloride (BaCl₂) is used as a water softener
- Barium oxide (BaO) easily absorbs moisture and is used as a desiccant
- Barium peroxide (BaO₂) forms hydrogen peroxide (H₂O₂) when it is mixed with water and is used as a bleaching agent that activates when wet
- Barium titanate (BaTiO₃) is used as a dielectric material in capacitors
- Barium ferrite (BaO·6Fe₂O₃) is used to make magnets

Traditional GI Barium Preparations

- Developed to fill or coat
- Formulated to image a specific section of the GI tract
- Used for Single or Double Contrast imaging
- Varying densities and viscosities
**Liquid E-Z-PAQUE® BARIUM SULFATE SUSPENSION (60% w/v, 41% w/w)**

- For single contrast upper GI imaging
- Available in powder and liquid forms

*See Indications and Important Safety Information on slide 43

**E-Z-PAQUE®**

**Changes**

Attempt to mirror thin liquid
- Cannot obtain the true viscosity of water and maintain adequate opacification/visualization

Used as nectar
- Viscosity range is not targeted for swallow studies (400-750 cP)

Sometimes mixed with pre-thickened liquids
- Not a true viscosity match
- Waste of pre-thickened beverage

*See Indications and Important Safety Information on slide 43

**E-Z-PAQUE®**

**Barium Sulfate Esophageal Cream (60% w/w)**

- Designed specifically to coat the esophagus
- Very adhesive/sticky properties

**E-Z-PASTE®**

- Designed specifically to coat the esophagus
- Very adhesive/sticky properties

**Typical uses in MBS**
- Used as puree or pudding consistency
- Sometimes mixed with puree or pudding food products
- Sometimes used to thicken a barium mixture
- Used to opacify a cookie or cracker

*See Indications and Important Safety Information on slide 43

**E-Z-PASTE®**

**Challenges**

- Does not mimic natural food
- Can leave residual coating that can affect diagnostic accuracy and make data interpretation more difficult
- Must apply clinical judgment whether residual barium is due to patient impairment or barium adhesiveness
- Can be unpleasant for the patient

*See Indications and Important Safety Information on slide 43
**E-Z-HD™**

**Barium Sulfate for Suspension (98% w/w)**

- For double contrast upper GI imaging
- Sold as a powder

**E-Z-HD™**

**Barium Sulfate for Suspension (98% w/w)**

- For double contrast upper GI imaging
- Sold as a powder

**Typical Uses in MBS**

- Sometimes used as nectar; sometimes used as honey
- Sometimes mixed with pre-thickened liquids

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**Typical Uses in MBS**

- Sometimes used as nectar; sometimes used as honey
- Sometimes mixed with pre-thickened liquids

**Liquid POLIBAR® PLUS**

**Barium Sulfate Suspension (105% w/v, 58% w/w)**

- For double contrast lower GI imaging
- Very dense and heavy coating
- Viscosity pattern seen in thixotropic liquids like paint

**Typical Uses in MBS**

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Review of the problems

- Lack of standardization
- Variability of viscosities and flow characteristics
- Undesirable coating
- Non-uniform opacification
- Prep time
- Waste

VARIBAR® Barium Sulfate Contrast Agent (40% w/v)* was developed to address these issues

Developing standards for materials in MBS studies is a key concern throughout the SLP community

1999 National Institute of Health (NIH) grant: Protocol 201 Study (Robbins & Logemann)

- Assess the efficacy of chin tuck & thickened liquids as treatment strategies

NIH mandated system controls required that diagnostic materials must be standardized for accurate comparisons

Approached E-Z-EM for assistance that would fit specific research needs

4 Components for Standardization and Differentiation

1. Single, defined values for thin liquid, nectar, honey & pudding viscosities, measured at a constant shear rate
2. Contrast agent must not leave residue on oropharyngeal structures when swallowed normally
3. Barium sulfate concentration had to be standardized at 40% w/v
4. Each viscosity had to be formulated to provide flavors & textures to help elicit salivation and a natural swallowing action in patients

Viscosity was selected for initial standardization since the ultimate goal in dysphagia treatment is to slow the rate of liquid flow through the oropharynx.

Viscosity, measured in centipoise (cP), describes frictional resistance to flow.
**The Solution**

VARIBAR® is the only premeasured, premixed barium preparation for modified barium swallow (MBS) studies, removing the uncertainty that comes with measuring and mixing prior to testing.

VARIBAR® was created with full input from the SLP community when developing the viscosity targets, concentration percentage and other product features.

**Development Considerations**

VARIBAR® THIN LIQUID™’s viscosity value needed to be as close to that of water as possible (0 cP)

The centipoise (cP) value of each viscosity level had to fall within a certain average range so that each suspension is neither too thin nor too thick. VARIBAR® THIN LIQUID®, NECTAR, HONEY, and PUDDING viscosity values must be far enough apart to avoid any overlap between each categorical thickness.

**VARIBAR® Today**

Five consistent, standardized viscosity ranges—at 40% w/v ratio of barium sulfate concentration across the product line—that correlate with thickened fluids and foods:

- **THIN LIQUID**
- **NECTAR**
- **THIN HONEY**
- **HONEY** (original honey)
- **PUDDING**

**VARIBAR® THIN LIQUID**

- Simulates water viscosity
- Target viscosity: 4 cP
- Viscosity range: <15 cP
- Apple Flavor
- Powder reconstitutes with water
- In-use stability: 72 hours under refrigeration
- Viscosity is essentially unaffected by temperature

**VARIBAR® NECTAR**

- Nectar consistency
- Target viscosity: 300 cP
- Viscosity range: 150-450 cP
- Apple Flavor
- In-use stability: 21 days at room temperature
- Viscosity is affected by temperature

**VARIBAR® HONEY**

- Honey consistency
- Target viscosity: 1500 cP
- Viscosity range: 800-1800 cP
- Apple Flavor
- In-use stability: 21 days at room temperature
- Viscosity is affected by temperature

Additional notes:

- THIN HONEY was developed in response to clinicians’ request for a closer match to pre-thickened liquids.
- In-use stability: 72 hours under refrigeration.
- Viscosity is essentially unaffected by temperature.
- When measured at a shear rate of 30 sec⁻¹ at 25 degrees C. This shear rate value is well within the range associated with chewing and swallowing (10-100 sec⁻¹).
Comparison with other contrast agents used for MBS

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>VARIBAR®</th>
<th>OTHER CONTRAST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specifically designed and optimized for the MBS</td>
<td>✔</td>
<td>☐</td>
</tr>
<tr>
<td>Standard Density: 40% w/v ratio of barium sulfate concentration</td>
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<td>☐</td>
</tr>
<tr>
<td>Uniform specification for consistent visualization</td>
<td>✔</td>
<td>☐</td>
</tr>
<tr>
<td>Standardized viscosity ranges for reliable, reproducible results</td>
<td>✔</td>
<td>☐</td>
</tr>
<tr>
<td>Viscosity Measured at Ideal Shear Rate</td>
<td>✔</td>
<td>☐</td>
</tr>
<tr>
<td>Viscosity Measured at Standardized Temperature</td>
<td>✔</td>
<td>☐</td>
</tr>
<tr>
<td>Smooth non-gritty texture with a mild flavoring added to improve patient acceptance and cooperation</td>
<td>✔</td>
<td>☐</td>
</tr>
<tr>
<td>Minimal coating and flow characteristics closely mimic regular liquids and foods</td>
<td>✔</td>
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</tbody>
</table>

In Conclusion...

In today’s healthcare environment of evidence-based practice, VARIBAR® provides a clinical standard for diagnostic accuracy and reproducible results.

Common Questions

- What if the patient is allergic to barium?
- What if the patient has had a prior contrast reaction?
- Why do some patients say they were constipated and others say they had diarrhea after prior barium exams?
- Why does the doctor sometimes insist on using an iodinated contrast instead of barium?
- What should patient expect after the exam?
- Are these natural or real fruit flavorings?
- Are there any animal products in the barium?
- Are the barium products gluten free?
- Is the barium shortage over??????

VARIBAR® Indications and Important Safety Information

**INDICATIONS AND USAGE:**

These products are indicated for use in radiography of the esophagus, pharynx and hypopharynx. VARIBAR® is indicated for adult use only.

**IMPORTANT SAFETY INFORMATION:**

For Oral Administration: This product should not be used in patients with known or suspected gastrointestinal tract perforation, or hypersensitivity to barium sulfate or any component of this barium sulfate formulation. Rarely, severe allergic reactions of an anaphylactoid nature have been reported following administration of barium sulfate agents.

Please see full Prescribing Information.

You are encouraged to report negative side effects of prescription drugs to the FDA. Visit www.fda.gov/medwatch or call 1-800-FDA-1088.


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INDICATIONS AND USAGE

LIQUID POLIBAR PLUS® BARIUM SULFATE SUSPENSION (105% w/v, 58% w/w), 1900 mL jug
Indications: For radiographic visualization of the gastrointestinal tract.

IMPORTANT SAFETY INFORMATION:
For Oral and Rectal Administration: This product should not be used in patients with known gastric or intestinal perforation, or hypersensitivity to barium sulfate products. Rarely, severe allergic reactions of anaphylactoid nature have been reported following administration of barium sulfate contrast agents.
Please see full Prescribing Information.
You are encouraged to report negative side effects of prescription drugs to the FDA. Visit www.fda.gov/medwatch or call 1-800-FDA-1088.

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