Systematic Review Article

Upper Gastrointestinal Cleaning Scores: A Narrative Review

Alireza Doostian[1], Maziar Nikouei[2], Mahsa Mohammadi[3], Saleheh Khorasani[4], Mohsen Rajabnia [5,6*]

[1] Department of Pharmacology, School of Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran

[2] Social Determinants of Health Research Center, Research Institute for Health Development, Kurdistan University of Medical Sciences, Sanandaj, Iran

[3] Rajaei Clinical Research Development Unit, Alborz University of Medical Sciences, Karaj, Iran

[4] Student Research Committee, Alborz University of Medical Sciences, Karaj, Iran

[5] Non-Communicable Diseases Research Center, Alborz University of Medical Sciences, Karaj, Iran

[6] Gastrointestinal and Liver Diseases Research Center, Iran University of Medical Sciences, Tehran, Iran

ABSTRACT

Background:
Esophagogastroduodenoscopy (EGD) relies on clear mucosal visualization for accurate diagnosis. Currently, there is no validated scoring system for assessing upper gastrointestinal (GI) mucosal cleanliness, unlike colonoscopy, leading to a risk of missing early gastric cancers.

Materials and Methods:
In this review, we identified three scores in our search related to GI cleaning scores and evaluated three scoring systems for upper GI mucosal cleanliness: the POLPREP scale, the Toronto Upper Gastrointestinal Cleaning Score (TUGCS), and the Barcelona Cleanliness Scale. Each study's methodology, validation process, and results were analyzed for reliability and applicability. The POLPREP scale evaluates the esophagus, stomach, and duodenum with scores from 0 (poor visibility) to 3 (excellent visibility). It demonstrated good intra- and inter-observer repeatability through image-based assessments. The TUGCS, developed using the Delphi methodology, focuses on the fundus, body, antrum, and duodenum, excluding the esophagus.

Results:
It showed excellent test-retest reliability (score 0.83) using video recordings. The Barcelona scale assesses cleanliness in five upper GI segments, scoring from 0 (non-aspirate solid or semi-solid material obstructing visibility) to 2 (nearly 100% mucosal visibility). It also demonstrated high inter- and intra-observer agreement (kappa value 0.82) through image-based assessments.

Conclusion
All evaluated studies highlight the need for standardized scales to improve mucosal visualization during EGD. Each study confirmed the repeatability and reliability of their scoring systems, despite methodological differences.
Therefore, developing a standardized, validated scoring system for upper GI cleanliness is essential for improving EGD diagnostic accuracy.

Keywords: Upper gastrointestinal tract endoscopy, Esophagogastroduodenoscopy, Upper gastrointestinal cleansing, Upper gastrointestinal preparation

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**Corresponding Author:*
Mohsen Rajabnia, MD
Address: Non-Communicable Diseases Research Center, Deputy of Research and Technology of Alborz University of Medical Sciences, Safarian street, Golshahr, Karaj, Iran
Tel: +98 26 34643774
Fax : + 98 26 34643922
Email: dr.rajabnia@outlook.com

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INTRODUCTION:

Esophagogastroduodenoscopy (EGD) relies on adequately visualizing the upper gastrointestinal (GI) mucosa. The evaluation of the foregut can be compromised by the presence of mucus, foam, bubbles, fluid, and solid material (1).

EGD is a fundamental diagnostic tool for examining the upper GI tract. The cleanliness of the mucosa during colonoscopy is routinely assessed using several validated scales, serving as a quality measure for lower GI endoscopy. Similarly, the proper visibility of the mucosa during EGD is crucial for detecting early lesions in the upper GI tract. However, unlike colonoscopy, no validated scoring system for assessing the cleanliness of the upper GI mucosa has been established thus far (2). Improving the assessment of mucosal visualization during EGD could benefit from a standardized scoring system.

Recent meta-analyses have highlighted a risk of 10%–14% for missing early gastric cancers during routine EGD. The failure to detect neoplastic lesions can be attributed to several factors, with poor mucosal visibility being a significant concern. Inadequate cleansing of the GI mucosa can lead to missed lesions obscured by mucus or bile, prolong the procedure, and necessitate repeat examinations at shorter intervals (3).

In 2006, the first guideline for the quality of upper GI endoscopy was published, proposing several quality standards by the American Society for Gastrointestinal Endoscopy and the American College of Gastroenterology (4). Subsequently, other societies, such as the European Society of Gastrointestinal Endoscopy and the United European Gastroenterology, have published their guidelines. Recognizing the importance of mucosal visualization, GI organizations such as the American Society for Gastrointestinal Endoscopy and the British Society of Gastroenterology have included it as a quality measure for EGD. The British Society of Gastroenterology guidelines recommend quantifying mucosal visualization, while the European Society of Gastrointestinal Endoscopy suggests providing information about residual contents in the stomach (5, 6).

Several studies have demonstrated the effectiveness of pre-EGD cleaning agents in enhancing endoscopist-rated visualization and improving the detection of gastric lesions. Common solutions used for this purpose include N-acetylcysteine, simethicone, and pronase (7). In comparison, there are numerous validated scales for lower GI visualization, such as the Ottawa Bowel Preparation Scale (OBP) and the Boston Bowel Preparation Scale (BBPS). A widely accepted and validated scale for EGD has yet to be developed. The Boston scale, a semi-quantitative assessment of stool presence and mucosal visibility after necessary cleansing maneuvers, is the most widely used and validated scale for colonoscopy (8, 9).

MATERIALS AND METHODS

1. Database

For this study, an extensive search was conducted across various research databases, including PubMed, Google Scholar, and other relevant websites, to collect articles from reputable journals with high citation rates.

2. Selection

The focus was placed on upper GI cleansing scores for esophagogastroduodenoscopy, with particular attention to studies published within the last decade. However, a comprehensive review of all articles from 2000 to 2024 was also carried out. Additional sources were identified by examining the references within the selected works. Priority was given to articles that specifically explored the upper GI cleansing scores. In total, four articles were evaluated.

3. Analysis

The study employs content analysis as its analytical method, allowing readers to develop a thorough and detailed understanding of upper GI cleansing scores for esophagogastroduodenoscopy. This process involves organizing and synthesizing information gathered from the reviewed literature.

Review of the Literature:

In the article written by Marcin Romańczyk and colleagues in 2021 "Scoring System Assessing Mucosal Visibility of Upper Gastrointestinal Tract: The POLPREP Scale," the POLPREP scale evaluated the esophagus, stomach, and duodenum separately after mucosal cleansing. The scoring is as follows:

Score 3: Clean mucosa or minor amounts of transparent fluid not impeding mucosal inspection.

Score 2: Small amount of hazy fluid, foamy, or solid content enabling inspection of most of the mucosa.

Score 1: Substantial amount of opaque fluid, foamy, or solid content that does not allow evaluation of some parts of the mucosa.

Score 0: Substantial amount of fluid or foamy content completely obscuring evaluation of the mucosa.

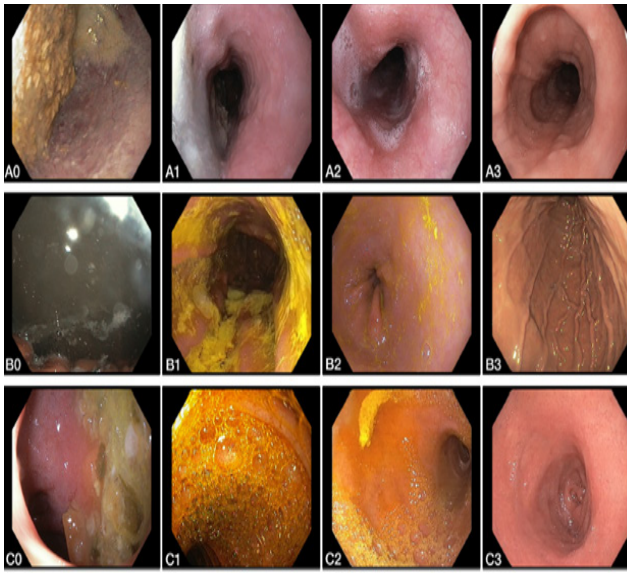
RESULTS:

18 images (six each for the esophagus, stomach, and duodenum) were selected from EGD photographs assessed in the study. These images were provided to 12 endoscopists who evaluated them twice at 2-week intervals (Figure 1). The intra-observer repeatability, based on Fleiss' kappa, was 0.64 overall. During the validation round, images

and endoscopy reports of 443 EGDs were assessed. The study aimed to develop an easy-to-use, standardized scale applicable not only for research but also in real-life endoscopy settings. This was achieved by following the principles of the Boston Bowel Preparation Scale.

The study found that the lesion detection rate was higher in "clean" versus "unclean" segments, with score 3 showing over three-fold higher lesion detection compared to score 1. The main limitation of the study is its retrospective design, which prevented the quantification of the number of photographs for each score.

The study proposed a novel tool to assess the quality of mucosal visibility in the upper digestive tract, demonstrating good intra-observer and inter-observer repeatability, as well as ease of use in real-life scenarios. However, its limitations include the use of EGD images rather than live or video-based assessments (10).



It categorizes mucosal visibility for different sections of the upper gastrointestinal tract as follows: For the esophagus, scores range from A0 (poor visibility) to A3 (excellent visibility); for the stomach, scores range from B0 (poor visibility) to B3 (excellent visibility); and for the duodenum, scores range from C0 (poor visibility) to C3 (excellent visibility). Each score is illustrated with representative photographs (10).

Figure 1. The POLPREP scoring system

In another study conducted in 2021 and 2022, the validation of the mentioned scale for diagnosing clinically significant lesions in the upper GI tract was examined. This study, conducted by Romańczyk and colleagues, was a prospective study, unlike the previous one, and was carried out in five endoscopy centers under the supervision of the Medical University of Silesia. The participants in the study included all individuals over 18 years of age who were referred for diagnostic EGD. Among them, pregnant individuals, those with hypertension and coagulation disorders, individuals with a history of GI surgery, and those ineligible for biopsy due to medication-related reasons were excluded from the study. Before the endoscopy procedure, all endoscopists had access to educational resources, which included instructions for performing endoscopy using the scale and scoring system under study. All patients underwent endoscopy after fasting for at least 2 hours for liquids and six hours for solids. Each endoscopist assessed the cleanliness of each part of the upper GI tract, including the esophagus, stomach, and duodenum, and reported if simethicone was used during the procedure. They rated patient tolerance on a 0 to 3 scale, where 0 indicated severe discomfort, 1 moderate discomfort, 2 mild discomfort, and 3 good tolerances. Additionally, they evaluated the cleanliness of each section after using all cleansing techniques, based on an expanded 0 to 3 scale (0: completely obstructed; 1: poor; 2: good; 3: excellent). The scoring system was named PEACE (Polprep: Effective Cleanliness Assessment in Upper Gastrointestinal Endoscopy).

The primary outcomes of this study included the assessment of cleanliness scores for sections of the upper GI tract based on the PEACE system and the diagnosis of clinically significant lesions (CSL). In this study, these lesions refer to those that require further action or intervention, such as optical evaluation, biopsy, or medical treatment. They were defined as follows in various sections:

Esophagus: Esophageal polyps, erosive reflux esophagitis, suspected esophageal metaplasia, esophageal ulcers, esophageal tumors, and submucosal lesions in the esophagus.

Stomach: Gastric polyps, gastric ulcers, gastric tumors, and submucosal lesions in the stomach.

Duodenum: Duodenal polyps, duodenal ulcers, duodenal tumors, and submucosal lesions in the duodenum.

Of the 2,985 sections of the GI tract examined in this study, 2,154 sections received a score of 3, 757 sections received a score of 2, and 74 sections received a score of 1. The rates of CSL for scores 1, 2, and 3 were 13.5%, 23.8%, and 21.6%, respectively, with the detection rate for score 2 being significantly higher than for score 1. Additionally, the detection rate of gastric polyps for scores 2 and 3 was significantly higher than for score 1. Across all sections, the polyp detection rate in sections with a score of 2 was significantly higher than in those with a score of 3. In sections with adequate cleanliness (score ≥ 2), the detection rate for CSL was approximately 1.78 times higher, and the detection rate for polyps was 2.38 times higher, both of which were statistically significant. It is also worth noting

that all neoplastic lesions were found in sections that had high scores according to the PEACE scale. At the end of the study, it was concluded that adequate mucosal cleanliness, as assessed by the PEACE scale, has a direct impact on the detection of CSLs in the upper GI tract. Therefore, this scale can be used as a standard method for measuring cleanliness levels in the upper GI tract during endoscopy (11).

In the article written by Rishad Khan and colleagues in 2022 " The Toronto Upper Gastrointestinal Cleaning Score: A Prospective Validation Study", The Toronto study validates the feasibility of classifying the cleanliness and clarity of the upper GI tract using previously tested statistical methods.

The Toronto Upper Gastrointestinal Cleaning Score (TUGCS) study was divided into two phases: the development of the scale and its validation. The TUGCS was created using the Delphi methodology, which involves systematically gathering the expertise of specialists. Their Delphi panel included 14 international endoscopists who participated in multiple rounds of rating various aspects of mucosal visualization on a Likert scale from 1 (strongly disagree) to 5 (strongly agree) (Figure 2).

The final TUGCS tool focuses on four anatomical areas: the fundus, body, antrum, and duodenum, excluding the esophagus from the scoring. The TUGCS was applied to 55 consecutive live esophagogastroduodenoscopies (EGDs), all of which were video recorded. The scoring system for each anatomical area is as follows:

Score 0: Presence of any solid food, blood or blood clots, or other content that could not be suctioned or washed, or an obstruction that prevented adequate visualization of the majority of an anatomical area.

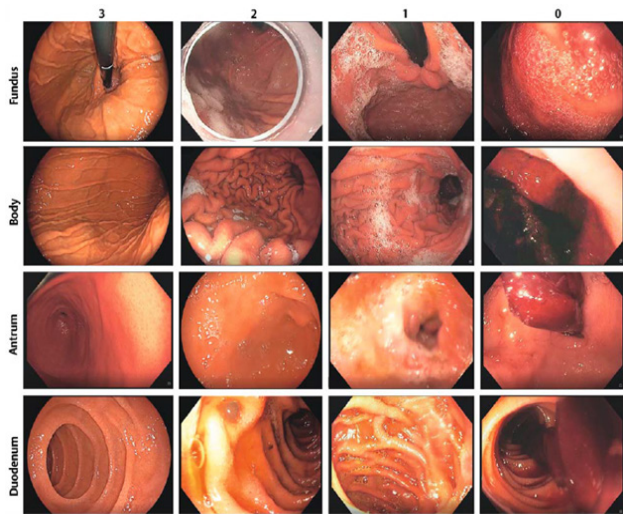
Score 1: Presence of mucus, bubbles, liquid content, or blood requiring both suctioning and washing.

Score 2: Presence of non-adherent liquid content or blood requiring only suctioning but not washing.

Score 3: Entire mucosa is well seen without the need for suctioning or washing.

The total score ranges from 0 (poor visibility in all segments) to 12 (excellent visibility in all segments without any suctioning or washing).

In the validation phase, 13 expert endoscopists graded each video using the TUGCS. Two weeks later, the same videos were rated again in a different order to assess test-retest reliability. This approach, commonly used in bowel preparation literature, demonstrated excellent test-retest reliability with a score of 0.83, exceeding the accepted threshold of 0.8 (12).



It assesses cleanliness in four segments: fundus, body, antrum, and duodenum, with scores as follows: Score 0: Presence of solid food, blood, or other materials that obstruct visualization, making it impossible to see most of the anatomical area. Score 1: Presence of mucus, bubbles, liquid, or blood that requires both suctioning and/or washing. Score 2: Presence of non-adherent liquid or blood that needs only suctioning, not washing. Score 3: Complete visibility of the mucosa without needing suctioning or washing (12).

Figure 2. The Toronto Upper Gastrointestinal Cleaning Score (TUGCS)

In the article written by Henry Cordova and others in 2023 "Applicability of the Barcelona scale to assess the quality of cleanliness of mucosa at esophagogastroduodenoscopy ", similar to the Toronto study, research was divided into two phases: the development of the scale and the evaluation of its validation applicability.

The development of the Barcelona Cleanliness Scale involved two expert endoscopists who applied a scoring system ranging from 0 to 2 points for each criterion (Figure 3):

Score 0: Non-aspirate solid or semi-solid material, presence of bile or foam that obstructs visualization of most of the mucosa.

Score 1: Small amount of semi-solid material, bile, or foam, allowing visualization of most of the mucosa.

Score 2: Absence of any remnants, enabling nearly 100% visualization of the mucosa.

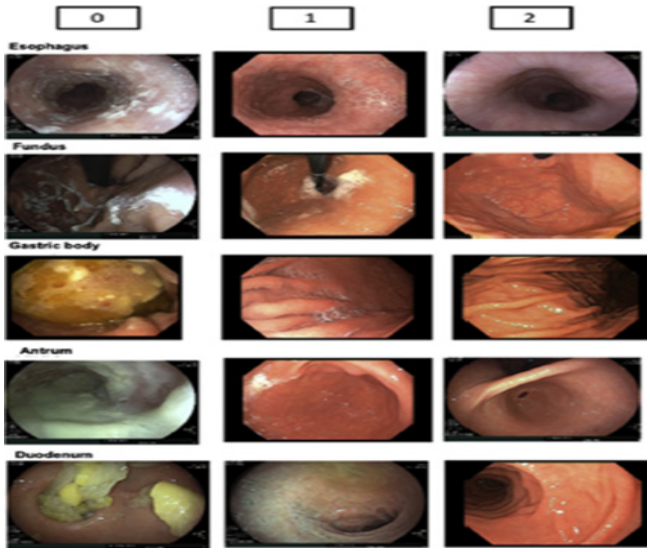
Partial scores were aggregated to derive a composite score ranging from a minimum of 0 to a maximum of 10, where a higher score indicated better cleanliness with minimal solid residues or residual fluids.

The validation applicability of the scale was initially assessed by seven expert endoscopists, followed by a

reassessment by 15 endoscopists to evaluate inter- and intra-observer variability. Reassessment of images one month later calculated intra-observer variability, yielding a mean kappa value of agreement of 0.82 between each endoscopist and the final score.

The fundamental principles underlying the Barcelona Cleanliness Scale for esophagogastroduodenoscopy (EGD) are akin to those used in developing the Boston scale for colonoscopy. However, distinguishing between Scores 1 and 2 may present challenges.

The primary objective of this study was to establish a reliable and reproducible scale for assessing cleanliness during EGD procedures. The Barcelona scale utilized image-based assessments, and in total, 1500 assessments were performed (13).



It assesses cleanliness in five segments of the upper gastrointestinal tract—esophagus, fundus, body, antrum, and duodenum—using a score from 0 to 2. A score of 0 indicates non-aspirate solid or semi-solid material, bile, or foam obstructing most of the mucosa; a score of 1 reflects a small amount of semi-solid material, bile, or foam that allows visualization of most of the mucosa; and a score of 2 signifies the absence of residues, providing nearly 100% visibility of the mucosa (13).

Figure 3. The Barcelona Scale

Table 1. Comparison of Upper Gastrointestinal Cleaning Scoring Systems

Feature	POLPREP Scale	TUGCS (Toronto)	Barcelona Scale
Year / Author	2021 / Romańczyk et al.	2022 / Khan et al.	2023 / Cordova et al.
Segments scored	Esophagus, stomach, duodenum	Fundus, body, antrum, duodenum	Esophagus, fundus, body, antrum, duodenum
Scoring range (per segment)	0 (poor) – 3 (excellent)	0 (solid/ obstructing) – 3 (clear, no suction/wash needed)	0 (obstructed) – 2 (nearly 100% visible)
Total score range	0–9	0–12	0–10
Assessment method	Image-based	Video-based	Image-based
Esophagus included?	Yes	No	Yes
Validation Study	Retrospective (2021), Prospective (PEACE, 2022)	Prospective	Prospective
Reliability/ reproducibility	Kappa: 0.64 (intra-observer), PEACE: Validated	Test-retest score: 0.83	Kappa: 0.82 (intra-observer)
Clinically significant lesion (CSL) detection data	Yes (PEACE study: CSL rates stratified by score)	Not specifically addressed	Not specifically addressed
Advantages	Simple, segmental, validated prospectively	Delphi-based, video closer to real-time, high reliability	Highest inter/ intra-observer agreement, wide scope
Limitations	Initial study retrospective; image-based only	Single center, excludes esophagus	3-point scale may limit precision; distinction 1 vs 2 unclear

DISCUSSION:

All four articles emphasize two primary components: the development of the scales and the subsequent validation and reproducibility of these scales. The Polish article provides limited details on the development process but has conducted a relatively thorough validation, supported by a large sample size (14). The TUGCS study demonstrated a higher standard of statistical testing and addressed potential bias by soliciting feedback from the Delphi panel to clarify rating anchors and providing a brief introduction to raters before using the TUGCS (15). Despite numerous statistical

analyses, which they themselves deemed acceptable, the TUGCS study was conducted at a single institution, and the small number of participants may limit the generalizability of its findings (15). However, each study performed various statistical tests that, due to differences in methods and study populations, are not directly comparable. The Barcelona study, like the Polish study, used photographs for their scoring, while the Toronto study employed videos, which seemed to be closer to real-life scenarios (14-16). However, A key limitation of the Toronto study is that it did not include the esophagus in its evaluation scale, whereas the other two studies did incorporate the esophagus (14-16). In the Barcelona study, although it examined the entire upper GI tract and achieved greater agreement among observers compared with the other studies, there is a notable difference: unlike the four-point system used by the other scales, the Barcelona scale applies a three-point scoring system (16). This difference may account for the higher consistency observed among endoscopists in the Barcelona study. Additionally, this study offered a more comprehensive and detailed evaluation of the stomach than the other two studies. It is notable that the primary criticism of the POLPREP study was due to its retrospective design; however, the more recent study by Romańczyk and colleagues (the PEACE study), as previously mentioned, addressed this issue by re-evaluating the scale in a prospective design (11). This second study highlighted another advantage of the POLPREP scale over the other two scales by specifically assessing its effectiveness in detecting clinically significant lesions (11). According to the latest database information, no separate study has yet evaluated the effectiveness of the Barcelona and Toronto scales in identifying clinically significant lesions, and sufficient data on their performance in this area are lacking. As noted, each scale has specific strengths and limitations relative to the others. Despite these differences, the reliability and reproducibility of these scoring systems have been examined, with statistical tests indicating acceptable results. Thus, additional research with larger sample sizes is still necessary to create an accurate and standardized scoring system for performing effective upper GI endoscopy.

CONCLUSION:

All evaluated studies demonstrate that scoring is a completely repeatable process in the statistical tests performed. This is probably the most important conclusion drawn from the analysis of these studies. While there is an inherent subjective component in the qualitative description of mucosal visualization, the consistency and reliability across these studies suggest that these scoring systems have real potential to improve the quality and effectiveness of EGD practice. Consequently, developing a universally accepted and validated scale for upper GI mucosal visualization is essential for enhancing diagnostic accuracy and improving patient outcomes.

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The authors have no relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript.

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AUTHOR CONTRIBUTIONS:

Mohsen Rajabnia had the idea for the article. Alireza Doostian & Mohsen Rajabnia performed the literature search and data analysis. The first draft of the manuscript was written by Maziar Nikouei, Saleheh Khorasani & Alireza Doostian. Mahsa Mohammadi revised the draft. All authors read and approved the final manuscript.

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