



## Type of Anesthesia Affects the Assessment of Gastroesophageal Junction in Patients Evaluated for Anti-Reflux Surgery

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### Abstract

**Background:** This study assesses the intra-rater agreement of assigning Hill grade to pre-operative endoscopy under Intravenous Sedation (IVS) versus under General Anesthesia (GA).

**Methods:** Fifty-three patients studied prospectively underwent both a preoperative endoscopy under IVS and a second endoscopy under GA just prior to surgery. These endoscopies were recorded and eight general surgeons experienced reflux surgery evaluated each endoscopy. Intra-rater agreement was assessed by comparing Hill grade assessment of the GEJ under IVS versus their Hill grade assessment under GA.

**Results:** There was a significant difference in assigning Hill grades under IVS versus GA in seven raters. Significantly, Hill grade was larger under IVS in 43% of cases.

**Conclusion:** In this study, type of anesthesia affected the endoscopic assessment of the GEJ, favoring a larger Hill grade assignment under IVS than GA.

**Keywords:** Gastroesophageal; Reflux; Hiatal hernia; Endoscopic; Endoluminal; Fundoplication; Transoral

### Introduction

Transoral fundoplication has shown effectiveness in treating gastroesophageal reflux disease in well defined populations [1-3]. Initial indications for therapy emphasize the importance of evaluation of the gastroesophageal junction for adequate therapeutic outcomes [4], and further study indicates that the condition of the gastroesophageal junction and the size of the esophageal hiatus are important factors in the outcomes of transoral fundoplication [5]. Although axial displacement [6] is a major determinant of the hiatal hernia component Hill grading criteria [7] has been adopted in the field of transoral fundoplication to further describe the condition of the gastroesophageal junction and its appropriateness for transoral fundoplication [1-4]. Investigators participating in this study perceived differences in how the gastroesophageal junction was rated, according to Hill criteria, at the initial evaluation endoscopy and at endoscopy at the time of surgical therapy for gastroesophageal reflux disease. It is postulated that differences in anesthesia in terms of positive or negative pressure ventilation, may account for these differences in evaluation.

### Methods

#### Patients

Fifty-three patients underwent evaluation of the esophagus, stomach and duodenum with video endoscopy as part of a prospective registry approved by the institutional review board. All patients underwent evaluation and treatment by a single investigator with extensive experience

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in the evaluation and treatment of gastroesophageal reflux. Patients found to be candidates for surgical therapy of their gastroesophageal reflux disease then underwent an endoscopy just prior to undergoing laparoscopic hiatal hernia repair and transoral fundoplication. Patients included were aged 18 to 75 years with gastroesophageal reflux disease of greater than one year duration, history of proton pump inhibitor use greater than 6 months, moderate to severe typical or atypical gastroesophageal reflux symptoms off proton pump inhibitors, and proven gastroesophageal reflux by endoscopy, ambulatory pH testing or barium swallow. Patients were only included if they received surgical treatment for their gastroesophageal reflux disease. These patients were asked to consent to both still and video documentation of their disease process and review of their medical and surgical evaluation and treatment of gastroesophageal disease. Consent was obtained for video and photographic recording of images during at the time of each intervention. Exclusion criteria include inability to record video due to technical considerations of both preoperative and presurgical endoscopy, prior gastric or esophageal surgery, Los Angeles Class D esophagitis [8] on their presurgical endoscopy, a body mass index greater than 35 kilograms per meter squared, portal hypertension or esophageal varices, esophageal ulcer, fixed esophageal stricture or narrowing, intestinal metaplasia of the esophagus >2 cm, gastroparesis confirmed by solid-phase gastric emptying study, active gastroduodenal ulcer disease, gastric outlet obstruction or stenosis, any coagulation disorder, esophageal motility disorder, pregnancy or plans for pregnancy in the next 12 months or enrollment in another device or drug study.

### Preoperative assessment

Patients were evaluated for gastroesophageal reflux disease by obtaining an extensive medical history, physical evaluation, and use of medications to treat their reflux symptoms. Patients were also evaluated as indicated with endoscopy with or without pH monitoring, barium swallow, manometry, solid-phase gastric emptying study, laboratory studies, and cholescintigraphy. All patients clinically determined to have gastroesophageal reflux underwent gastro Esophagoduodenoscopy (EGD), most often with biopsy, to evaluate their anatomy and the presence of any other pathology. Hiatal hernia was evaluated by mucosal junction (z-line) position in relation to the diaphragmatic impression, the axial displacement of the z-line position, an estimation of the greatest transverse diameter of the hiatal opening, and a Hill criteria assignment. Video recordings were made of their preoperative evaluation endoscopy performed under IVS and the immediate presurgical endoscopy performed under GA. All preoperative evaluations were performed using Propofol (Astra Zenca) as the IV sedation agent, and were ventilating spontaneously during the evaluation. All presurgical patients underwent initial induction with IV sedation and paralytic agent then underwent intubation and maintenance of anesthetic with inhalational agent. All presurgical patients were under positive pressure ventilation at the time of endoscopy.

### Endoscopy

Endoscopy was performed by a single provider using standard video endoscopy equipment with recording of each procedure. The patient's upper gastrointestinal tract was inflated with air while the endoscope was advanced through the esophagus, body, antrum and into the duodenum to allow initial distension of the gastric pouch. The endoscope was withdrawn to perform antral biopsies as indicated, and then a retroflex view was used to evaluate the body, fundus and cardia

of the stomach. In the retroflex view, insufflation was continued until gastric rugal folds were flattened, and then continued another 60 sec to fully distend the cardia into any hiatal defect. The endoscope was then withdrawn to evaluate the position of the gastroesophageal mucosal junction in relation to the diaphragmatic impression and measure the distance from the gastroesophageal mucosal junction to the incisors. Biopsies were taken of the distal esophagus as indicated.

### Video assessment

Endoscopy videos were edited to represent a 30 sec or less view of the maximally insufflated gastroesophageal junction. Random numbers generated by computer were assigned to each video in order to blind evaluators to any other video or conditions at the time of endoscopy. Evaluators were already experienced in using Hill criteria in their own practice setting, but to insure uniformity were given a copy of the original Hill article and asked to review the Hill criteria publication as well as video representations of each Hill grade category immediately prior to the evaluation session. Evaluators were shown the representative study videos and asked to rate the view of the gastroesophageal junction according to the Hill criteria. One hundred and six videos met criteria for evaluation. Eight community general surgeons with experience in anti-reflux surgery evaluated each video. These eight surgeons average 11 years in private practice with an average of 6 endoscopies per week and 3 years in transoral fundoplications experience. They independently and blindly evaluated each video and assigned a Hill grade (I, II, III or IV) to the appearance of the GEJ on a scoring sheet immediately after reviewing the examples of the four Hill grades. Statistical analysis was performed using Minitab 15 statistical software (Minitab Inc., State College, PA). The Kappa ( $\kappa$ ) coefficient was used to express the intra-rater agreement between a video of each gastroesophageal junction when evaluated under IVS and then under GA. The closer the  $\kappa$  value is to 1, the more agreement there is; a  $\kappa$  value closer to zero indicates less agreement.

### Results

In only one of 8 raters, there was no significant difference between endoscopic Hill grade assessments under IVS vs. GA. This rater had 53% (28/53) of cases matched ( $P=0.358$ ) However, the associated Cohen's Kappa value was indicating a poor agreement ( $\kappa=0.16$ ). The agreement across Hill grades (I, II, III and IV) in this rater was strongest for Hill grade III ( $\kappa=0.22$ ; fair agreement) and lowest for Hill grade I ( $\kappa=-0.07$ ; agreement occurs less often than predicted by chance alone). There was a significant difference in assigning Hill grades under IVS vs. GA in other seven raters. In these seven raters, the proportion of matched cases ranged from 26% to 53% and associated P value ranged from 0.002 to 0.043. However, in 6 of 7 raters, the associated measure of agreement was considered poor ( $\kappa$  ranged from -0.03 to 0.152). One rater was considered to have fair agreement ( $\kappa=0.23$ ). Of these seven raters, 3 had the highest agreement by assigning Hill grade IV, 2 by assigning Hill grade III and 2 by assigning Hill grade II. Hill grade assignment was larger under IVS in 43% of cases; in 20% of the cases the surgeons found the Hill grade larger under GA than IVS.

### Comments

Transoral fundoplication has increasingly been used to treat gastroesophageal reflux disease. The use of transoral fundoplication is preferred by our group of practitioners to avoid the commonly known side effects of the Nissen-style fundoplications. As experience is gained, the selection criteria for patients who are most likely to have

long term success are being developed. In our experience, accurate evaluation of the gastroesophageal junction is paramount in selecting appropriate candidates. What we noted was a difference in what we thought we saw in workup and what we were seeing at the time of surgery, leading to a question of the evaluation methods and setting at each interval. The Hill criteria are often quoted in literature and have become the common rating system of the gastroesophageal junction among those of us who perform transoral fundoplications. We use this rating system to determine who would benefit from a transoral fundoplications vs. a hiatal hernia repair first followed by the transoral fundoplication, because it gives us a sense of whether the hiatus is too wide and would allow movement of the fundoplication into a position above the diaphragm, either immediately, or in the near future. In this study, each investigator acts as their own control, comparing their own evaluation of a patient under IVS to their evaluation of the same patient under GA. Earlier investigations have shown the importance of accurately grading the gastroesophageal junction, with the critical decision made in assigning a Hill 2 grade versus a Hill 3 grade. Hill 2 grade would indicate that the patient could undergo a transoral fundoplication alone and have results consistent with published literature on transoral fundoplications. Hill 3 grade would indicate that a hiatal hernia repair was indicated. Without hiatal hernia repair, transoral fundoplication has been shown to have early and significant increases in failure rates [6]. This study indicates that Hill grading is significantly altered among surgeons experienced in making Hill grade evaluations when the anesthesia setting differs between IVS and GA. The difference is postulated to be due to intrathoracic pressure differences in patients who breathe on their own under IVS using negative intrathoracic pressure versus those with positive pressure ventilation while under GA. The underestimation of the need for hiatal repair in up to 43% of the cases may indicate a falsely elevated failure rate for the transoral fundoplications technique when used without hiatal repair.

## Conclusion

In this study, intra-rater agreement in assigning Hill grade to the videos of patients undergoing endoscopic evaluation was inconsistent between IVS and GA. Hill grades were underestimated during GA in 43% of the cases.

## Funding

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