

Paraesophageal Hernia and Reflux Prevention: Is One Fundoplication Better than the Other?

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Abstract

Background The management of paraesophageal hernia (PEH) is one of the most debated in surgery. Trends regarding indications, approach (open, laparoscopic, thoracoscopic), sac excision, mesh placement, and routine performance of fundoplication have changed over time. Today, most surgeons tend to perform a laparoscopic PEH repair that entails the excision of the sac, liberal use of a mesh to buttress the hiatus, and the addition of an anti-reflux procedure. Nevertheless, very little has been written on which type of fundoplication should be performed in these patients. Therefore, the goal of our study was to provide an evidence-based overview of which type of fundoplication should be performed during a PEH repair and the role of preoperative function tests in the decision-making

Methods We searched the MEDLINE, Cochran, PubMed, Google Scholar, and Embase databases for papers published between 1996 and 2016 pertaining to the surgical treatment of PEH. We hand-searched the bibliographies of included studies and we excluded all reviews and case reports. We selected clinical studies and technical reports. We only considered papers stating rationales for the type of fundoplication performed.

Results Our search yielded 24 articles: 17 clinical studies and 7 technical reports. In five of the clinical studies, a fundoplication was added only to patients with reflux symptoms. In all clinical studies, the most performed procedure was a total fundoplication (Nissen or Nissen-Rossetti), whereas a partial fundoplication (Toupet more frequently than Dor) or no fundoplication was reserved to those with impaired esophageal motility. All seven technical reports recommended a tailored approach and suggested adding a partial fundoplication (mainly Toupet) when the manometric findings showed esophageal dysmotility.

Conclusion The argument of whether or not a fundoplication should be added to a PEH repair in patients without evidence of reflux still persists. However, this review highlights that, when a fundoplication is performed, a tailored approach based on preoperative function tests is almost always preferred.

The original version of this article was revised: Piero Marco Fisichella's given name was incorrect.

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Introduction

The management of paraesophageal hernia (PEH) is one of the most debated in surgery. Trends regarding indications, approach (open, laparoscopic, thoracoscopic), sac excision, mesh placement, and routine performance of fundoplication have changed over time. Today, most surgeons lean to perform a laparoscopic PEH repair that entails the excision of the sac, liberal use of a mesh to buttress the hiatus, and the addition of an anti-reflux procedure. The rationale of including an anti-reflux procedure is to treat coexistent reflux or to prevent the onset of “de novo” postoperative reflux [1, 2]. In fact, many studies have shown that in the majority of patients a PEH is associated with symptoms—even subtle—of dysphagia, bloating, or gastroesophageal reflux disease (GERD), and that an extensive hiatal dissection could exacerbate GERD postoperatively by impairing the anatomical anti-reflux barrier [3]. Already in 1996, a work by Wo et al. [4] showed that 68% of patients with type III PEH had a history of heartburn. Interestingly, many of these patients (41%) no longer had GERD symptoms at the time the operation, and the authors attributed this finding to the flap valve created by the stomach above the gastroesophageal junction, suggesting that, in most patients, a type III paraesophageal hernia may be an enlarging sliding hernia. A recent double-blinded randomized controlled trial by Muller-Stich et al. [5] has validated the addition of an anti-reflux procedure by showing that a fundoplication during a PEH repair results in a net improvement in patients’ symptoms with reduced acid exposure and esophagitis. However, very little has been written on which type of fundoplication should be performed in these patients. In general, a total fundoplication is the preferred approach in patients with GERD, as it provides a better control of reflux than a partial fundoplication [6]. Conversely, recent trends have highlighted how in patients with PEH a partial fundoplication could provide—especially in the absence of preoperative manometric data—a satisfactory balance between prevention/control of GERD and prevention of postoperative dysphagia.

We have endeavored to explore the question “Is one fundoplication better than the other in those with PEH?”, and we

have set as the goal of our study that to provide an evidence-based overview of which type of fundoplication should be performed during a PEH repair and the role of preoperative function tests in choosing the type of fundoplication.

Materials and methods

We searched the MEDLINE, Cochran, PubMed, Google Scholar, and Embase databases for papers published between 1996 and 2016 pertaining to the surgical treatment of PEH to address one key question: “Is one fundoplication better than the other in those with PEH?” (*Search string: (paraesophageal hernia [All Fields] OR hiatal hernia) AND fundoplication [All Fields] AND manometry [All Fields]*). We combined all articles in a single list, resulting in 172 abstracts. We selected all clinical studies mentioning a preoperative evaluation of esophageal motility and all the technical reports. We only considered papers stating rationales for the type of fundoplication performed. We limited our search to English language articles; we hand-searched the bibliographies of included studies, and we excluded all reviews, case reports, commentary or opinion pieces, review articles that reported data included in other selected references, and articles containing primary data duplicated in other papers. Our search yielded 24 articles (Fig. 1), which we reviewed according to guidelines from Preferred Reporting Items for Systematic Reviews and Meta-Analyses [7]. Evidence tables are reported in Tables 1 and 2.

Importance of preoperative esophageal testing

There seems to be little agreement on the best preoperative evaluation of patients with PEH. Generally, an esophagram (or a CT scan) and an upper endoscopy (EGD) are requested to evaluate the type of hernia and to exclude concomitant foregut pathologies. Regarding preoperative esophageal testing, the presence of esophagitis Los Angeles classification C or D, or Barrett’s esophagus, can be

Fig. 1 PRISM table

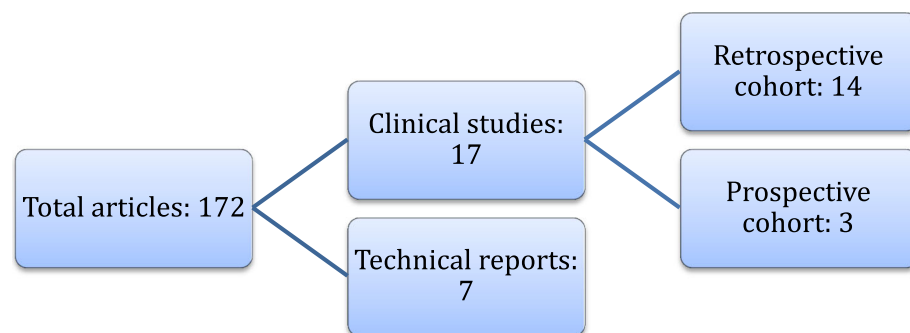


Table 1 Evidence table for the technical reports

Source	Article type	Preoperative evaluation	Types of fundoplication	Rationale
Cohn and Soper [32]	Technical report	Esophagram	Nissen	Based on manometry
		Endoscopy	Dor	Normal: Nissen
		Manometry	Toupet	Esophageal motility disorders: Dor or Toupet
Oleynikov and Jolley [34]	Technical report	Esophagram	Nissen	Based on manometry
		Endoscopy	Toupet	Normal: Nissen
		Manometry		Esophageal motility disorders: Toupet
DeMeester et al. [16]	Technical report	Esophagram	Nissen	Based on manometry
		Endoscopy	Toupet	Normal: Nissen
		Manometry		Esophageal motility disorders: Toupet
Soper et al. [35]	Technical report	Esophagram	Nissen	Based on manometry
		Endoscopy	Dor	Normal: Nissen
		Manometry	Toupet	Esophageal motility disorders: Dor or Toupet
Allaix et al. [45]	Technical report	Esophagram	Nissen	Based on manometry
		Endoscopy	Partial (type not specified)	Normal: Nissen
		Manometry		Esophageal motility disorders: partial fundoplication
		pH monitoring		
Auyang et al. [46]	Technical report	Esophagram	Nissen	Based on manometry
		Endoscopy	Dor	Normal: Nissen
		Manometry	Toupet	Esophageal motility disorders: Dor or Toupet
		pH monitoring		
Arafat et al. [31]	Technical report	Esophagram	Nissen	Based on manometry
		Endoscopy	Partial (type not specified)	Normal: Nissen
		Manometry		Esophageal motility disorders: partial fundoplication

considered an objective evidence of gastroesophageal reflux and might avoid further pH testing, which is usually performed to detect reflux prior to performing a fundoplication. During our review, we have found that in five studies the authors limited the performance of a fundoplication to patients with gastroesophageal reflux (GER) symptoms [8–12]. However, in three studies the authors improved their patients selection by adding objective measures of reflux (pH monitoring or EGD findings) [8, 9, 11], whereas two studies reported only the presence of typical GER symptoms (heartburn and regurgitation) as the main criteria for adding a fundoplication. In one of these studies, Leeder et al. [12] elected to perform a fundoplication in all patients since 1998, due to the excessive amount of reflux symptoms in the follow-up of patients who underwent a PEH repair without a fundoplication.

The debate whether to add or not a fundoplication still persists. Proponents of the addition of a fundoplication cite that GER symptoms have poor sensitivity and specificity [13–17] and are unreliable when deciding whether to perform a fundoplication or not. A preoperative pH monitoring would be the most appropriate tool in this decision-making, as it provides a more sensitive and specific assessment of the

presence and severity of GERD. However, due to the anatomical irregularity of the gastroesophageal junction in PEH, performing esophageal testing can be sometimes very challenging. In addition, proponents of these addition of a fundoplication cite that an extensive hiatal dissection, even in patients without preoperative reflux, impairs the gastroesophageal barrier with resulting “de novo” GERD [5, 18]. In fact, in the majority of clinical studies, we reviewed the authors encouraged to perform a fundoplication (total or partial) regardless the presence of GER symptoms [19–30]. In 5 of the 7 technical reports [31–35], the authors believed that pH monitoring had little value, as a fundoplication should have been routinely performed.

Esophageal manometry plays a more important role than pH testing in planning a fundoplication [14, 16, 36, 37]. The primary purpose of performing an esophageal manometry before an anti-reflux procedure is to exclude achalasia or other primary esophageal motility disorders, which would contraindicate total fundoplication and favor a cardiomyotomy. Esophageal manometry also helps detecting those patients with severe degree of hypomotility of the esophageal body that would contraindicate a total fundoplication in favor of a partial. In fact, several authors

Table 2 Evidence table for the clinical reports

Source	Study design	Candidates for AR surgery	Type of fundoplication: no. of patients	Main rationale for the type of fundoplication	Follow-up (months)	Postoperative dysphagia and further treatments
El Khoury et al. [20]	Retrospective cohort	All patients	Total: 92 Partial anterior: 58 Partial posterior: 9	Total: normal manometry Partial: esophageal motility disorders	24	Postoperative dysphagia was present in 28 patients. The authors did not go into the details about these patients (type of fundoplication performed, need for additional treatments)
Alicuben et al. [26]	Retrospective cohort	All patients	Total: 34 Partial posterior: 13	Total: normal manometry Partial: esophageal motility disorders	5	Two patients were converted to a partial posterior fundoplication because of recurrent dysphagia
Stiven et al. [13]	Retrospective cohort	All patients	Partial posterior: 114	Authors believe that manometry is often unreliable due to the distorted anatomy of the gastroesophageal junction; therefore, a partial fundoplication was routinely performed in order to avoid postoperative dysphagia	12	Three patients required dilation for postoperative dysphagia
Van Der Westhuizen et al. [13]	Retrospective cohort	Patients with reflux symptoms supported by endoscopy	Total: 130 No fundoplication: 22	Total: normal manometry No fundoplication: patients with esophageal motility disorders	14	Eight patients in the fundoplication group presented postoperative dysphagia
Mittal et al. [10]	Retrospective cohort	Patients with reflux symptoms	Total: 20 Partial posterior: 18 Partial anterior: 1 Roux-en-Y gastric bypass (RYGB): 4 No fundoplication: 30	Total/partial: normal manometry; type of fundoplication based on anatomic findings and fundus compliance No fundoplication: patients with esophageal motility disorders	60	Ten patients who underwent fundoplication required dilation for postoperative dysphagia
Furnée [9]	Prospective cohort	Patients reflux symptoms supported by objective evidence with pH monitoring or endoscopy	Total: 29 Partial posterior: 6 No fundoplication: 25	Total: normal manometry Partial: esophageal motility disorders	12	Three patients had dysphagia after a fundoplication, but the authors did not go into the details about these patients (type of fundoplication performed, need for additional treatments)

Table 2 continued

Source	Study design	Candidates for AR surgery	Type of fundoplication: no. of patients	Main rationale for the type of fundoplication	Follow-up (months)	Postoperative dysphagia and further treatments
Gouvas et al. [21]	Retrospective cohort	All patients	Total: 61 Partial posterior: 7	Total: normal manometry Partial: esophageal motility disorders. However, the authors divided the patients with impaired esophageal motility in two groups: 7 underwent partial posterior and 9 total fundoplication	12	Four patients after a total and two patients after a partial fundoplication presented with postoperative dysphagia
Dallemagne et al. [27]	Retrospective cohort	All patients	Total: 80 Partial posterior: 5	Even though manometry showed esophageal dismotility in nine patients, the procedure choice was a total fundoplication, and a partial wrap was reserved to patients with poor compliance of the gastric fundus	118	Two patients, after a total fundoplication, underwent reoperation for severe dysphagia because of an over tight fundoplication (the preoperative manometry is not reported)
Leeder et al. [12]	Retrospective cohort	Patients with reflux symptoms before 1998. All patients after 1998	Total: 16 Partial anterior: 11 Partial posterior: 6 No fundoplication (before 1998): 20	Type of fundoplication based on anatomic findings and the compliance of the gastric fundus	46	One patient, who underwent total fundoplication, required dilation for dysphagia
Ponsky et al. [23]	Prospective cohort	All patients	Partial posterior: 27 Partial anterior: 1	Authors believe that manometry is often unreliable due to the distorted anatomy of the gastroesophageal junction; therefore, a partial fundoplication was routinely performed in order to avoid postoperative dysphagia	24	One patient required dilation for postoperative dysphagia
Wiechmann et al. [22]	Retrospective cohort	All patients	Total: 41 Partial posterior: 18 Partial anterior: 1	Total: normal manometry Partial: disordered esophageal motility characterized by frequent tertiary contraction in the esophageal body (<30 mmHg)	19	All but 3 experienced symptomatic relief. The authors did not go into the details about these patients (symptoms, type of fundoplication performed, need for additional treatments)
Terry et al. [28]	Retrospective cohort	All patients	Total: 105 Partial posterior: 10 Partial anterior: 3	Total: normal manometry Partial: esophageal motility disorders (distal esophageal body peak amplitude lower than 30 mmHg or if <70% of wet swallows induced peristalsis)	26	Three total fundoplication were converted to a partial posterior because of dysphagia. Two of these patients also had a myotomy because of postoperative development of ineffective esophageal peristalsis
Swanstrom et al. [1]	Retrospective cohort	All patients	Total: 48 Partial posterior: 4	Total: normal manometry Partial: esophageal motility disorders	18	Three patients among total fundoplication group presented with dysphagia (two required dilation)

Table 2 continued

Source	Study design	Candidates for AR surgery	Type of fundoplication: no. of patients	Main rationale for the type of fundoplication	Follow-up (months)	Postoperative dysphagia and further treatments
Medina et al. [8]	Retrospective cohort	Patients with reflux symptoms supported by endoscopy	Total: 10 Partial posterior: 5 No fundoplication: 5	Total: normal manometry Partial: esophageal motility disorders	20	Two patients presented dysphagia after a total fundoplication, requiring dilation
Gantert et al. [29]	Retrospective cohort	All patients	Total: 10 Partial posterior: 30	Total: normal manometry Partial: esophageal motility disorders (distal amplitude of esophageal peristalsis of 40 mmHg or less)	11	Three patients presented dysphagia: two after total and one after partial posterior fundoplication, all requiring dilation
Edye et al. [30]	Prospective cohort	All patients	Total: 30 Partial posterior: 7	Total: normal manometry Partial: esophageal motility disorders No fundoplication: esophageal motility disorders	29	Two patients with normal preoperative esophageal motility presented with dysphagia after total fundoplication. One required dilation
Perdikis et al. [19]	Retrospective cohort	All patients	Total: 64 Partial posterior: 1	Total: normal manometry Partial: esophageal motility disorders	18	Four patients, who underwent total fundoplication, required dilation for dysphagia

have convened that when the esophageal contraction amplitude (or, in another words, the pressure needed to pass a food bolus past a total fundoplication) is <30–40 mmHg, then a partial fundoplication should be considered to prevent postoperative dysphagia [38, 39]. Nevertheless, we have found that the definition of dysmotility varied among the studies.

In all seven technical reports, we found that the authors routinely performed esophageal manometry prior to PEH repair to identify patients with motility disorders that would exclude them from receiving a total fundoplication for fear of developing postoperative dysphagia. Similarly, we found that in 15 of 17 clinical studies an esophageal manometry was routinely performed to assess the esophageal peristalsis, although only three authors described the criteria used to define impaired esophageal motility—“frequent tertiary contractions and marginal peristaltic amplitude of contraction in the esophageal body (<30 mmHg)” [22], or “distal esophageal body peak amplitude lower than 30 mmHg or if less than 70% of wet swallows induced peristalsis” [28], or “distal amplitude of esophageal peristalsis of 40 mmHg or less” [29]. In two studies [23, 24], the esophageal motility was not assessed because the authors performed a partial fundoplication regardless.

Is one fundoplication better than another?

Carrott et al. [40] suggested that symptoms associated with paraesophageal hernia are varied, and that truly asymptomatic patients are rare. In this single-center review of 270 consecutive patients undergoing surgical repair of paraesophageal hernia, Carrott et al. found that symptoms included heartburn (65%), early satiety (50%), chest pain (48%), dyspnea (48%), dysphagia (48%), and regurgitation (47%). Due to the difficulty in evaluating the esophageal motor function in some of these patients and the common preoperative complaint of dysphagia [2, 39, 40], we have found that some surgeons preferred to perform a partial fundoplication, rather than a total fundoplication [23, 24]. In fact, a partial fundoplication might be associated with fewer functional problems—leading to persistent dysphagia postoperatively—than a total fundoplication in those patients who might have undiagnosed impaired esophageal motility [39]. However, there has been little objective evidence to support this trend, and one might argue that the overall durability of a partial fundoplication in the control of reflux might be less reliable than that of a total fundoplication [41–44].

Among the technical reports, we found a large agreement to perform a partial fundoplication (either posterior or anterior) in patients with impaired esophageal motility, even though none of the authors clearly described the manometric

patterns prompting to a partial fundoplication. Allaix et al. [45] suggested performing a total fundoplication as the procedure of choice, while reserving a partial fundoplication in cases of severe esophageal dysmotility or during emergencies, when the patient presents with signs and symptoms of incarceration or strangulation. The rationale of this approach was that patients are frequently elderly, often they do not have preoperative esophageal manometry, and a partial fundoplication might also be an effective form of gastropexy. Conversely, Arafat et al. [31] routinely performed manometry in all patients, and in those with a challenging insertion, they placed the manometry catheter with the help of an endoscope. Arafat et al. suggested performing a partial fundoplication when manometry showed aperistalsis or severe dysmotility, yet not objectively defined. Auyang et al. [46] suggested performing a partial fundoplication in patients with 90% or more failed peristaltic contractions. Cohn et al. shunned from a total fundoplication in all patients with aperistalsis and those with severe dysphagia with inability to pass the manometry catheter. DeMeester [33] reported that a fundoplication should always be added to all PEH repairs and the type of fundoplication should be selected on the basis of the patient’s esophageal motility. Similarly, in the remaining two technical reports [34, 35] the authors based their choice of fundoplication on the patient’s “poor motility.”

Among the clinical studies, we found amore heterogeneous approach. Overall, on a combined number of 1252 patients, 770 (62%) had a total fundoplication, 262 (22%) a partial posterior and 74 (6%) a partial anterior fundoplication. In the remaining 127 patients, 4 had a Roux-en-Y gastric bypass (RYGB) for obesity (BMI > 40 kg/m²), and 123 had no fundoplication.

In the studies by Ponsky and Stiven, all 142 patients underwent PEH repair with a partial fundoplication selected by default: 141 partial posterior (270° Toupet) and 1 partial anterior (180° Dor, due to the anatomical difficulties in performing a posterior wrap). At a mean follow-up of 17 months, no patient reported reflux symptoms, while 4 (3%) patients (1 in the Ponsky and 3 in the Stiven study) presented with postoperative dysphagia requiring endoscopic dilation [23, 24].

In the other 15 studies, the authors routinely performed an esophageal manometry, which was overall accomplished in 79% of patients [8–12, 19–22, 25–30]. In two studies, by Mittal et al. [10] and Van Der Westhuizen et al. [10, 11] no fundoplication was performed in patients with impaired esophageal peristalsis, and in patients with normal motility, the type of fundoplication was chosen according to gastric anatomy and fundus compliance. Overall, on a combined number of 225 patients, 150 (66.5%) underwent total fundoplication, 18 (8%) partial posterior fundoplication, 1 (0.5%) partial anterior

fundoplication, 4 (2%) a gastric bypass for obesity (BMI > 40 kg/m²), and 52 (23%) had no fundoplication. Postoperatively, at a mean follow-up of 29 months, 18 patients (12%) who underwent a total fundoplication presented with dysphagia, with 10 requiring endoscopic dilation. Eleven patients presented postoperatively with symptoms of reflux, seven after a total fundoplication (4.6%), and four after PEH repair alone (7.7%), yet no postoperative pH monitoring was performed [10, 11]. Interestingly, Dallemagne et al. and Leeder et al. routinely performed a preoperative manometry and stated that they considered a total fundoplication as the procedure choice in all patients, while they reserved a partial fundoplication only to those with little compliance of the gastric fundus [12, 27]. Overall, on a combined number of 118 patients (96 total fundoplication, 11 partial anterior, and 11 partial posterior), we found that among patients with total fundoplication, three had postoperative dysphagia (3%); two required a conversion to a Toupet fundoplication and 1 improved after endoscopic dilation. Among these 118 patients, 21 (18%) had postoperative reflux symptoms, although the authors do not specify how many received a total or a partial fundoplication. In addition, no objective measure of reflux was given after the operation.

In 11 studies [8, 9, 19–22, 25, 26, 28–30], the authors based their procedure of choice on manometric results, adding a total fundoplication only to patients with normal esophageal motility. An exception is the study by Gouvas et al. where the authors divided the 16 patients with abnormal esophageal motility in two subgroups: one group of nine patients who received a total fundoplication, and another group of seven patients who received a partial posterior fundoplication. At 12 months of follow-up, Gouvas et al. [21] showed that four patients (44%) after a total fundoplication and two patients (29%) after a partial fundoplication presented with postoperative dysphagia. Conversely, four patients (57%) presented with reflux symptoms after a partial fundoplication, while one patient (11%) presented with GER symptoms after a total fundoplication. In addition, all 16 patients underwent postoperative esophageal pH monitoring and all of those with a partial fundoplication had an abnormal amount of reflux (mean DeMeester score of 33), while 4 out of 9 patients (44%) after a total fundoplication had an abnormal amount of reflux (mean DeMeester score of 39).

In ten studies [8, 9, 19, 20, 22, 25, 26, 28–30], the authors chose a partial posterior or anterior fundoplication (the type of partial fundoplication was at surgeon's discretion) in those with impaired esophageal motility. Among these grouped patients, 103 underwent a partial posterior and 62 a partial anterior fundoplication. Unfortunately, the outcomes are not reported in the same way by the different authors, as here the goal was not to evaluate the outcomes of a tailored approach.

Overall, at a combined mean follow-up of 18 months, 50 (7%) patients presented with postoperative dysphagia and 58 (8%) with symptoms of reflux. Of the 50 patients with dysphagia, 18 underwent a total fundoplication, and post operatively 12 required dilation and 5 a reoperation (conversion to Toupet). One patient had dysphagia after a partial posterior fundoplication, but did not require further treatments. Regarding the remaining 31 of 50 patients with postoperative dysphagia, the authors did not go into the details of their management (type of fundoplication performed, need for additional treatments) [9, 20]. Of the 58 grouped patients presenting with postoperative reflux symptoms, 13 patients underwent a total fundoplication and 3 underwent a partial fundoplication. As for postoperative dysphagia, we have found that the authors did not go into the details of management in the remaining 42 patients with GER symptoms [9, 20, 25].

Conclusions

We have shown that in the majority of the studies we have reviewed the authors preferred to add a fundoplication to all PEH repairs, preferably a total fundoplication in patients with normal esophageal motility. Despite this widespread tailored approach, as of today there is no evidence in literature that a fundoplication is better than another in preventing reflux and avoiding dysphagia in patients undergoing PEH repair, and the small prospective/retrospective and non-comparative studies in the literature do not help in drawing definitive conclusions.

Compliance with ethical standards

Conflict of interest The authors have no conflict of interest to declare.

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