# Endoscopic Dilatation with Ultrathin Endoscope Assisted Method for Esophageal and Pyloric Stricture related Corrosive Injury: 4 Years Case Series Study

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## ABSTRACT

*Corrosive injuries (CI) become medical problems related complications include esophageal, pyloric stricture and squamous cell carcinoma, physical and quality of life. Endoscopic (ED) dilatation is primary therapy. The ultrathin endoscope-assisted method is potentially safe and useful in avoiding technical failure. Describe clinical outcomes of ED ED-related CI including successful, refractory, recurrent, and complications-related procedures. Case series study of esophageal and/or pyloric stricture patients after CI who underwent dilatation at Soetomo General Hospital (July 2018 – July 2022). One – biweekly ED using Through The Scope (TTS) balloon or Savary Bougie dilator. The target diameter is 14mm. Fifteen patients with stricture-related CI. Eleven patients underwent ED with a total of 73 procedures. Mean age 31,45 years, predominantly male patients (6), suicide attempt (7), acid agent (9), located at esophagus (3), pylorus (3), or both (5). Number of esophageal dilatation to achieve the target of 14 mm was 1-2 and 2-15 procedures for simple and complex stricture. Five esophageal strictures were successfully dilated but 2 patients were recurrent and 3 cases were refractory to ED. Pyloric dilatation resulted in a lower success rate. Recurrent and refractory cases were 5 and 3 patients respectively. ED with ultrathin endoscope method is useful for traversing guidewire during ED. Ongoing inflammation and fibrosis were linked to recurrent and refractory stricture.*

***Keywords**: Corrosive injury, dilatation, esophageal, pyloric stricture.*

## INTRODUCTION

Corrosive injuries still become medical problems in the acute phase and also delayed complications include esophageal, pyloric stricture, and squamous cell carcinoma,[1] impairing social, physical, emotional, and quality of life.[2] About 13.5% - 22% of the patients will develop strictures.[4-6] Strictures on the esophagus and pylorus are the most prevalent delayed sequelae and endoscopic dilatation is the primary therapy.[7]

In the last 4 years (2018-2022) there were

36 corrosive injuries at the Endoscopy unit of Dr. Soetomo General Hospital Surabaya with 15 (41.6%) strictures on the esophagus, pylorus, or both. Esophageal strictures related to corrosive injury are frequently long, tight,[8,9] and multiple sites, which require endoscopic or surgery intervention.[2,10] Endoscopic dilatation is the first-line therapy for stricture-related corrosive injury.[2] However, due to tight, long, or tortuous stricture and insufficient visualization of the distal side of the lesion, endoscopic management is not always possible[4] and treated under fluoroscopy to ensure proper guidewire placement before dilatation. Because radiologic facilities are not available in most endoscopy units, the initial assessment and treatment may be delayed.[11] One of the most important steps in dilatation is the proper placement of the guide wire beyond the stricture.[4] The ultrathin endoscope (≤ 6mm) could pass through the stricture easier than a conventional endoscope, allowing the guide wire to be inserted, evaluate the distal side of the lesion, and measure the length and characteristics of the stenosis.[4]

This study will describe the clinical outcome of endoscopic dilatation with Ultrathin Endoscope Assisted Method including clinical improvement, success rate, refractory rate, recurrent rate, and complications during and after procedures.

## METHODS

Case series study of patients with esophageal and/or pyloric stricture after corrosive injury who underwent endoscopic dilatation at Soetomo General Hospital from July 2018 – July 2022.

Data such as age, gender, caustic agent, type of stricture, number of dilatations, increasing of body weight and outcome of endoscopic therapy were recorded.

Anatomical type of stricture was classified into simple and complex. Simple strictures are the symmetric or concentric, short, diameter of 12 mm or more and easily passed by an endoscope. Complex structures are asymmetry, diameter <12 mm, or inability to pass an endoscope.[12]

All procedures were performed under general anesthesia. First, conventional gastroscope (GIF-HQ190, Olympus) was inserted into the stricture area. If conventional endoscope guide wire insertion failed, and an ultrathin endoscope (GIF XP260; Olympus) was traversed and approached directly in front of the stenotic lesion orifice. The guidewire was inserted through the working channel of the ultrathin endoscope and then removed completely, leaving the guide wire in place.

The opposite side of the guide wire was grabbed and retrieved through the working channel of the conventional scope.[4]

Endoscopic dilatation was performed using Through The Scope (TTS) balloon dilator or Endoscopic bougie dilatation. An endoscopic TTS balloon dilator was inserted using a guidewire through an accessory channel with a minimum of 5 mm to a maximum of 18 mm diameter. The dilator was slowly inflated with liquid to certain pressures, usually 1, 2, and 3 atmospheres, and maintained for 2–3 min and then deflated. The procedure will be repeated two or three times with a stepwise larger pressure to achieve the target diameter gradually from gradual stepwise dilatation from a 75 diameter of 5 mm to 7, 9, 11-, 12.8-, 14, and 15-mm.[13]

Endoscopic bougie dilatation was performed with a Wire-guided Polyvinyl dilator Savary-Gilliard/SG. The scope was introduced to evaluate the anatomy, and then the bougie dilator was passed over the metal guidewire. The first dilator was chosen based on the estimated diameter of the esophageal stricture. The sensation of resistance during dilatation on this dilator protects from over-dilatation.[10] To prevent adverse events particularly perforation we use the "Rule of Three" which means that the stricture is dilated no more than 3 mm per session using three consecutive bougies once moderate resistance is encountered.[14] After dilation, the endoscope was inserted to evaluate the dilatation and complications such as bleeding or perforation. Bougie dilation was the first choice to stretch the simple esophageal stricture. The tortuous, long esophageal stricture or pyloric stricture was dilated with a balloon dilator. One week after the first dilation, patients were advised to return to the hospital for endoscopic evaluation and re-dilatation until the target diameter of 14mm was

achieved. Triamcinolone acetonide was injected into the surrounding stricture area (4 quadrants, 20mg each).[8] All patients had written informed consent before endoscopic dilatation.

We followed the Kochman criteria definitions for refractory and recurrent strictures. The refractory stricture was classified if the diameter of the stricture could not reach 14 mm over four sessions of dilatation. Recurrent stricture happens if it cannot maintain a luminal diameter for 4 weeks once the target diameter of 14 mm had been achieved.[15] Esophageal dilatation can be performed under the combination endoscopy and fluoroscopy or endoscopy alone.[10]

Successful Outcome was defined as relief in dysphagia, increasing body weight, or achieving a diameter of 15 mm after endoscopic dilatation without requiring endoscopic procedure or surgical intervention for at least 6 months.[2]

## RESULTS

There were 15 patients with stricture-related corrosive injury with a total of 73 dilatation procedures. Three patients were referred to digestive surgery because of near-total obstruction with diffuse mucosal injury, whereas 1 patient refusedendoscopic dilatation. Eleven patients underwent endoscopic dilatations. Most dilatations were performed 6 months after injury (range 1 month to 1.5 years). Three patients had psychiatric problems (Schizophrenia paranoid, Baby blues syndrome, and Bipolar disorder) **(Table 1)**.

Two patients with simple esophageal stricture successfully dilated with SG dilator and scope dilatation in 1 session. Six patients had complex esophageal strictures with 5 of them located at two or more sites along the esophagus**. (Table 2)**

In complex stricture with very tight diameter we use slim scope, guidewire, and fluoroscopic guidance then introduce a TTS balloon dilator until a certain diameter which SG dilator can pass the stricture. As the diameter became larger then SG dilatation was inserted to achieve target diameter **(Figure 1)**.

**Table 1.** Clinical characteristics of patients with strictures related to corrosive injury.

| Characteristics | Results |
|---|---|
| Age | Mean 31.45 years |
| Sex | |
| Male | 6 |
| Female | 5 |
| Mode | |
| - Suicide attempt | 7 |
| - Psychiatric disorder | 3 |
| - Accidental | 1 |
| Time after injury to dilatation | |
| - 1-6 months | 6 |
| - 7-12 months | 1 |
| - > 12 months | 2 |
| - Not known | 1 |
| Location | |
| - Esophagus | 3 |
| - Pylorus | 3 |
| - Esophagus & pylorus | 5 |
| Agent | |
| - Acid (HCl 8.3% - 20 %) | 9 |
| - Alkali | 1 |
| - Unknown | 1 |
| Symptoms | |
| - Dysphagia | 11 |
| - Decreasing of body weight | 11 |
| Body weight | |
| - Before dilatation | Mean 46.6 kg |
| - fter Dilatation | Mean 51.9 kg |

The Number of dilatations to achieve the target of 14 mm was 1-2 and 2-15 for simple and complex esophageal stricture respectively. The number of dilatations was higher if the diameter of esophageal stricture was less than 0,6mm or long stricture. The time from injury to dilatations was an important factor because corrosive injury resulting an inflammatory and fibrotic process that continues several months after injury. Overall successful, recurrent, and refractory cases for esophageal dilatations were 7, 2, and 3 patients respectively **(Table 2)**.

For recurrent and failure to dilatation stricture we consider continuing endoscopic dilatation accompanied by Triamcinolone acetonide injection since the inflammatory and fibrotic process have not yet subsided.

Abdominal CT scan was performed for recurrent and refractory stricture to evaluate the characteristics of the stricture. Retrosternal pain after the procedure was recorded in 1 patient without any sign of perforation.

### Pyloric Strictures

Most of the pyloric strictures were complex and tight strictures. **(Figure 2).** Pyloric stricture (alone or combined with esophageal stricture) resulted in a lower success rate than esophageal dilatation. Five patients had recurrent and 3 patients had refractory pyloric stricture respectively. **(Table 2).**

Two patients were referred to digestive surgery because of the progression of the stricture with complete luminal stricture and the inability to identify the luminal orifice to insert a guidewire. These patients delayed their endoscopic schedule by themselves due to the pandemic while the fibrotic process progressed.

One patient was a candidate for surgery although there was an improvement in dysphagia and increasing in body weight. There was increasing in mean body weight after dilatation as an improvement of dysphagia symptoms **(Table 1)**.


**Figure 1.** Esophageal stricture with tight diameter, surrounded by fibrotic scar.

**Table 2.** Esophageal and pyloric stricture and clinical outcome.

| Stricture | Frequency (%) | Method | Number of dilatations to achieve target (Range) | Success (%) | Recurrent (%) | Refractory (%) |
|---|---|---|---|---|---|---|
| Esophagus | | | | | | |
| Simple | 2 | SG Scope dilatation | 1-2 | 2 (100) | 0 | 0 |
| Complex | 6 | SG TTS balloon | 2-15 | 5 (83) | 2 (33.3) | 3 (50) |
| Pylorus | | | | | | |
| Simple | 2 | TTS balloon | 1-2 | 2 (100) | 0 | 0 |
| Complex | 6 | TTS balloon | 2-17 | 3 (50) | 5 (83.3) | 3 (50) |

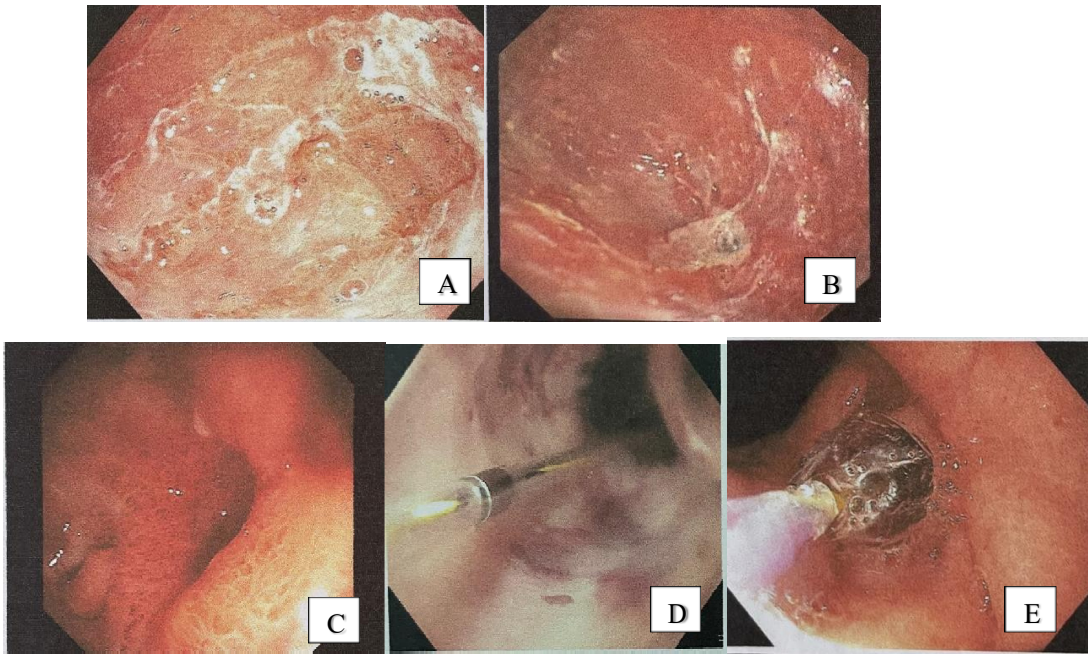


**Figure 2.** Pyloric stricture with tight diameter (A-C). Pyloric stricture with TTS balloon in place and direct visualization (D, E).

No complications such as infection, mediastinitis, or perforation were observed during or after the dilation sessions.

## DISCUSSION

The corrosive injury occurs when a wide range of chemical substances with pH<2 or pH>12 are swallowed accidentally or suicide attempt and cause tissue damage and destruction. Adults between the ages of 30 and 40 typically ingest strong corrosives with suicide attempts and present with severe, life-threatening injuries.[6] Due to the 'liquefaction necrosis' of alkaline substances, corrosive injury from alkali can be more damaging to the gastrointestinal tract than 'coagulation necrosis' from acid ingestion. Previous reports suggest that alkali usually destroys the esophagus, while acid primarily damages the stomach. But in case of massive ingestion, both acids and alkalis may cause extensive necrosis of the gastrointestinal tract. Strong acids result in coagulation necrosis that protects the esophagus from damage and penetration to the deep layer. The epithelial

layer and the alkaline pH on the esophageal wall had a protective effect. However, this study showed that acid substances had a destructive effect on both esophagus and gaster in almost similar proportions. Gastroesophageal reflux of corrosive agent due to impaired lower esophageal sphincter and motility dysfunction resulted in corrosive injury and stricture at the esophagus as well as gastric injury. Pyloric spasm prolonged gastric contact time and this explained the pyloric involvement in 8 patients in this study.[6,16] Corrosive injury located at the duodenum appeared to be rare and less severe because of pyloric spasms.[10] In this study, the dominant causative agents are strong acid substances (Hydrogen Chloride 8.3% -20%) from household cleaning that are easily accessible.

Acid ingestion is more common in Asian countries while alkali account for most severe caustic injuries in Western Europe and South America.[6,10] After strong corrosive agent ingestion, the esophagus can be divided into 3 stages as follows: (1) Acute necrosis and thrombosis occur 1-4 days after ingestion; (2) ulceration and granulation phase occur in 3-12 days. During this stage, mucosal shedding, bacterial colonization, and granulation formation are evident. The esophagus is in its most fragile stage. All operations such as laparoscopy or dilatation must be performed very carefully; (3) the healing period begins 3 weeks after the injury. It usually takes 1-6 months for the wound to heal completely. Any surgical attempt for non-dilatable stenosis should wait until after this period.[10]

During the third week, scar retraction leads to stricture formation and progresses over several months. Esophageal dysfunction due to scarring combined with gastroesophageal refluxwill accelerate scarring.[6]

The severity of the injury depends on the acidity of the agent, contact time, amount, and purpose of ingestion. The purpose has an important predictor and intentional ingestion (suicide); which is the mode of ingestion in this study is correlated with severe injury and stricture.[13,6] Patients at risk for stricture had a high endoscopic grade, consumed strong acids or alkalis, had leukocytosis, and had a low thrombin ratio.[10] The severity of esophageal wall stricture is determined by the depth of necrosis. In 100% of cases, full-thickness necrosis causes strictures and even perforation within 2 to 4 weeks.[16] The likelihood of developing a stricture after an esophageal burn of grade 2B and grade 3 may be 71% and 100%, respectively.[17]

Corrosive strictures can involve all oesophageal segments, multiple, long, irregular, and frequent refractory to dilatation compared to other causes of benign stricture. Dysphagia and decreasing body weight are the most common symptoms related to esophageal stricture or gastric outlet obstruction related to pyloric stricture. The most relevant symptom is progressive dysphagia to solid food, and this sometimes progresses to involve semisolid and liquid foods.[14] Some patients may present with nutritional deficiencies and weight loss in addition to persistent dysphagia or odynophagia.[18]

Endoscopic dilation is the first-line management option. Early endoscopic dilatation effectively prevents surgery. The best time for dilatation is after the acute injury has healed, which is usually around the third week. Late management is associated with significant fibrosis and collagen deposition in the esophageal wall, necessitating more endoscopic sessions for adequate dilatation and resulting in a significantly higher number of refractory and recurrent strictures. The practice is supported by the majority of evidence-based guidelines.[2,7,19] Other endoscopic modalities for esophageal strictures currently include needle knife dissection, argon plasma coagulation (APC), temporary stent placement, laser cannulation, and self-dilation. However, treatment options are limited if a complete luminal occlusion occurs.[20]

In this study 6 patients were admitted to the hospital and underwent endoscopic dilatation 1-6 months after injury. The improvement of symptoms and nutritional status is the main goal of treatment rather than conserving large oesophageal lumen patency.[6] A study by Tharavej et al reported that the majority of patients with acid-induced corrosive esophageal stricture required more sessions and were frequently refractor to dilatation. Esophageal dilatations were successful in one-fourth of the patients.

Concomitant cricopharyngeal stricture, long stricture, requiring frequent dilatation, and refractory to >11 mm dilatation were factors associated with failed dilatation.[13]

The type of dilator used will be determined by availability and experience with the particular device. There is no agreement on how these patients should be followed up. We do a dilatation program for short intervals (weekly or biweekly) until the ultimate goal of elimination of dysphagia is achieved then extended three weekly, one month, two months, or three months until persistent improvement and are already asymptomatic.

Esophageal dilatation using Savary bougies is preferred to balloon dilators although studies have shown no clear advantage of one method over the other.[6] Systematic review and meta-analysis showed that there was no difference in symptomatic relief, recurrence rate at 12 months, bleeding, or perforation between bougie and balloon dilation of benign esophageal stricture.[21] Balloon dilators delivered a radial and simultaneous dilating force across the entire length of the stricture, whereas bougie dilators delivered both a radial and a longitudinal force from the most proximal to the most distal portion of the stricture.[5] Joshi et al reported endoscopic dilatation with SG dilators was successful in 71.8% of patients whereas refractory and recurrent strictures were 1.5% and 7.8% respectively. Endoscopic dilatation outcome was associated with increasing stricture length (more than 6 cm).[2]

The ability to traverse any esophageal stricture is determined by the stricture's complexity.

Endoscopically, the presence of a patent lumen within the stricture and the diameter of the lumen are two important factors that determine the methods and success of traversing the stricture. As a result, the preferred techniques for traversing esophageal strictures will differ depending on whether the strictures are simple, complex with patent lumen, or complex with complete occlusion.[9] In this study, there were 6 complex esophageal strictures and 5 patients were successfully dilated.

Recurrent esophageal stricture in 2 patients happened 3 - 4 weeks after the target diameter was achieved. The strictures were complex, long, and multisite. Recurrent pyloric stricture was earlier and more frequent than esophageal stricture due to ongoing inflammation and fibrotic processes. (**Table 2)**. Although endoscopic balloon dilatation is effective in treating gastric outlet obstruction in patients with short strictures perforation and failure are common.[6] We recorded 1 patient with retrosternal pain without any sign of perforation.

Recurrent and refractory stricture after endoscopic dilatation needs further investigation and treatment. The response to dilatation can be predicted using CT or endoscopic ultrasound wall thickness. Patients with an esophageal wall thickness greater than 9 mm on CT scan required significantly more dilatations than those with a wall thickness less than 9 mm.[22] There are no established guidelines for the treatment of refractory strictures.[8] The emergence of interventional endoscopy has renewed interest in intraluminal stenting to prevent stricture recurrence after dilation. Although silicone rubber, polyflex, and biodegradable stents have shown promising results, their widespread clinical use is currently inhibited by issues such as hyperplastic tissue growth, removal difficulties, a high migration rate (25%), a high recurrence rate (50%), low availability, and high costs.[6]

Endoscopic stent placement can improve the duration of time without symptoms, dilate the stricture segment repeatedly, and reduce the suffering caused by repeated dilations. Most medical professionals believe that 4 to 8 weeks is the right amount of time for the esophageal stent to remain in place. If the duration is too short, the cicatricial tissue in the stricture segment cannot be organized completely, which increases the risk of recurrent strictures, and if the duration is too long, serious connective tissue proliferation is inevitable and stent removal becomes challenging.[2] Recurrence rates of refractory strictures after stent removal are as high as 69%, particularly in patients with long strictures (>7cm).[19] Intralesional steroid injections enhance the effects of endoscopic dilation, and topical mitomycin can be effective in the treatment of complex strictures; such combined approaches should be discussed before deciding on surgery.[6] Steroids had an inhibitory

effect on the inflammatory response to reduce stricture formation, collagen synthesis, fibrosis, and chronic scarring.[14]

It has been suggested that dilatations should be stopped and reconstructive surgery should be considered after five to seven unsuccessful sessions. However, additional patient-related considerations like age, malnutrition, and operative risks, as well as the surgeon's experience and the availability of other surgical choices.[6] In this study, 2 patients with recurrent and refractory stricture refused to perform digestive surgery and continued dilatation procedures. In the 15th session, the target dilatation was achieved.

Patients with dilatation failure may undergo esophageal replacement surgery using stomach, jejunum, or colonic conduits. In patients requiring esophageal replacement surgery, the timing of surgery, resection or bypass, type of conduit and route of placement, as well as the site of proximal anastomosis as determined by the extent of caustic injury to the hypopharynx and proximal esophagus, should all be carefully considered. A gastric pull-up is usually preferred in patients with isolated esophageal involvement, low stricture, and a normal stomach, whereas patients with pharyngo-esophageal strictures or combined esophageal and stomach involvement require a colonic conduit.[2] Regarding the adverse event, there was 1 patient with retrosternal chest pain and relieved with a killer drug. No perforation nor mediastinitis was recorded.

## CONCLUSION

Endoscopic dilatation with ultrathin-assisted method is useful to traverse guidewire through the stricture. Because stricture-related corrosive injury frequently has complex anatomical structure, more sessions are required, especially if the inflammation and fibrotic process have not subsided. Further studies with more samples are needed to determine factors correlated with clinical outcomes.

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