High-resolution oesophageal manometry and 24-hour impedance-pH study in systemic sclerosis patients: association with clinical features, symptoms and severity

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ABSTRACT

Objective. *To evaluate the associations between objectively measured gastroesophageal involvement using high-resolution manometry and 24-hour impedance-pH study, and clinical presentations in systemic sclerosis (SSc) patients.*

Methods. *This cross-sectional study was conducted in University of Malaya Medical Centre (UMMC) with 31 consecutive SSc patients recruited into this study. Clinical symptoms of gastroesophageal involvement, high-resolution impedance-manometry and 24-hour impedance-pH monitoring were assessed. Their associations with serological features and other organ involvement were evaluated.*

Results. *Twenty-five (80.6%) patients had gastroesophageal reflux disease (GORD) symptoms, mainly heartburn (45.1%), regurgitation (32.2%) and dysphagia (29%). Using manometry, oesophageal dysmotility was detected in 24 (88.9%) patients, while hypotensive lower oesophageal sphincter (LOS) was observed in 17 (63%) patients. 21 (84%) patients had GORD based on pH study. Hypotensive LOS was significantly associated with presence of digital ulcers. The main gastroesophageal symptoms were absent in majority of the SSc patients including in those with severe gastroesophageal manifestations demonstrating failed peristalsis >75%, hypotensive LOS, Demeester score >200 and acid reflux >200 per day. Demeester score >200 is associated with severity of GORD symptoms. Demeester score >200 was also associated with restrictive lung pattern (p=0.001). Significant association between GORD severity (daily number of acid reflux episodes >200) and pulmonary fibrosis was seen (p=0.030).*

Conclusion. *The presence and severity of gastroesophageal symptoms may not accurately reflect the seriousness of oesophageal involvement. GORD severity is associated with presence of restrictive lung pattern and pulmonary fibrosis. Oesophageal manometry and 24-hour pH study should be considered more frequently in the assessment of SSc patients.*

Introduction

Systemic sclerosis (SSc) is a common multisystem connective tissue disease associated with fibrosis and vascular damage (1). This disrupts the normal architecture of the tissues causing structural and functional impairment in many organs, including the gastrointestinal (GI) system (2). The pathophysiology of GI abnormalities in SSc is contributed to by both myogenic and neurogenic factors; as a consequence of initial vascular damage, leading to excessive collagen deposition in the submucosa and smooth muscle atrophy. Immunological abnormalities are also implicated in its pathogenesis, for example over-expression of profibrotic factors such as transforming growth factor β, endothelin-1 and connective tissue growth factor (3, 4).

Gastrointestinal manifestations occur in up to 90% of patients with SSc (5). Oesophageal dysmotility and gastroesophageal reflux disease (GORD) are frequent, contributing to increased morbidity and poor quality of life. Patients with oesophageal dysmotility commonly present with dysphagia and sensation of food getting stuck along the oesophagus; while GORD is associated with heartburn and/or reflux. Hypotensive lower oesophageal sphincter (LOS) and loss of peristaltic contractions in the oesophageal smooth muscle segments are known to

cause GORD (6). Hypotensive LOS is characterised by <10 mmHg pressure gradient between the gastric fundus and LOS. The condition is related to atrophy of the LOS smooth muscle and fibrosis. Delayed gastric emptying can further contribute to GORD in SSc patients (7, 8). The symptoms in oesophageal dysmotility and GORD may occur independently or overlap. Evidence of gastroesophageal manifestations as determined by routine objective testing often does not correlate with symptoms (9). The aim of the present study was to objectively evaluate gastroesophageal involvement in SSc patients and explore its association with clinical symptoms and other clinical presentations.

Materials and methods

This was a cross-sectional study conducted between March and November 2012. The patients were recruited prospectively at the University of Malaya Medical Centre (UMMC), a university teaching hospital. The study was approved by the University of Malaya Medical Ethics Committee (IRB reference no: 907.12) and was in compliance with the WMA Declaration of Helsinki 2013. Thirty-four consecutive SSc patients who fulfilled the 1980 American College of Rheumatology criteria of SSc were approached and 31 patients gave written informed consent to participate. Patients with a history of upper GI malignancy or previous GI surgery were excluded.

Medical record review

Demographic and clinical details were obtained from review of medical records. The patients were classified as having either limited cutaneous systemic sclerosis (lcSSc) or diffuse cutaneous systemic sclerosis (dcSSc). The presence or absence of the following features was determined: Raynaud's phenomenon, telangiectasia, digital ulcers, calcinosis, renal crisis, pulmonary arterial hypertension (diagnosed based on right heart catheterisation) and evidence of pulmonary fibrosis on chest x-rays or by high-resolution computed tomography (HRCT) of the thorax. Previous upper GI endoscopy results were also reviewed.

Patient interview

During the patient interview, the symptoms of oesophageal dysmotility and GORD were explored. Patients were asked to grade the severity of the symptoms, ranging from 'no symptom', 'mild' (could be ignored by patient), 'moderate' (could not be ignored, but had no effect on daily life activities) and 'severe' (affecting daily life activities). The frequency of symptoms (either weekly or daily) was also recorded (10).

Oesophageal assessment

Anti-secretory treatment and pro-kinetic agents were withheld 5 days prior to oesophageal assessment. We advised the patients to elevate head end of the bed during the night to minimise reflux. Patients were required to undergo 6 hours of fasting before the procedures. The oesophageal motility, LOS pressure and acidity were assessed by high-resolution manometry with impedance (ManoScan 360, Sierra Scientific Instruments, California, US) and 24-hour pH monitoring with impedance (AccuTrac, Sierra Scientific Instruments California, US), respectively.

High-resolution oesophageal manometry with impedance

The high-resolution oesophageal manometry catheter has a solid-state sensor that has 12 pressure-sensitive segments arranged circumferentially. After application of local anaesthetic gel, the catheter is inserted transnasally in the seated upright position. When the catheter is positioned appropriately, the sensing segment spans from pharynx to the stomach, so that a pressure profile of the entire oesophagus and its sphincters can be viewed simultaneously in real time. The resting pressure profile generated by the upper oesophageal sphincter and LOS are identified, and the patients were allowed to accommodate to the catheter in the seated upright position. The standard protocol started with a 30-second baseline recording during which no swallowing occurred, allowing determination of the resting characteristics of the upper oesophageal sphincter, LOS and diaphragm. This was followed by a series of at least 10 5-ml water swallows given in the sitting up position. A 20 to 30 second time interval was allowed to elapse between swallows, so that the lower oesophageal resting pressure returns to baseline before the next swallow.

24-hour pH monitoring with impedance

VersaFlex Z Disposable pH/Impedance catheter has a single channel pH sensor at 0 cm and 8 impedance rings at -3, -1, 1, 3, 5, 9, 11 and 13 cm relative to the markings. The catheter was inserted transnasally into the oesophagus and left for 24 hours or more. The pH sensor on the catheter is typically placed at 5 cm above the upper border of the LOS, which is pre-determined by the high-resolution oesophageal manometry. The catheter is connected to a data storage system. The patients were trained to press certain buttons to indicate specific events, such as mealtime, supine position, taking medication and onset of symptoms. The patients were also instructed to document GI symptoms in a diary.

This test provides characteristics of the reflux (acidic, weakly acidic or weakly alkaline reflux), acid exposure (%), Demeester score, symptom index (SI), and symptom association probability (SAP). Acid reflux is defined as refluxed gastric juice with a pH<4, which could be either reduction of the oesophageal pH to <4 or the oesophageal pH was already <4; weakly acidic reflux occurred when a reflux event resulted in an oesophageal pH 4-7; and weakly alkaline reflux occurred when reflux episodes happened during which nadir oesophageal pH does not drop below 7. Acid exposure (%) is the total time the pH is <4 divided by the time monitored. A total distal oesophageal acid exposure <4.2% over 24 hours was normal. Bolus exposure is analogous to acid exposure by adding the duration of all four reflux subcategories defined by the impedance, and dividing this value by the time monitored.

The Demeester score of pH monitoring is a global measure of oesophageal acid exposure based on six parameters (percentage total time pH <4, percentage upright time pH <4, percentage

supine time pH <4, number of reflux episodes, number of episodes >5 minutes and longest reflux episode in minutes) with a cut-off value of 14.72 (11). The SI was the number of symptoms associated with reflux divided by the total numbers. SAP was calculated as the probability that the observed distribution could have occurred by chance. SI and SAP were considered positive when the values were >/= 50% and >/=95%, respectively.

Autoantibody testing

Serum SSc-specific autoantibodies were tested in all the patients using the Euroline immunoblot Ig-G technique, which consisted of antibodies against Scl-70, centromere antigen subunits (CENP A, CENP B), PM-Scl-100, PM-Scl-75, Ku, Ro-52, RNA Polymerase III subunits (RP11 and RP 155), Fibrillarin (U3RNP), NOR-90, Th/To, and PDGFR.

Statistical analysis

Analyses were performed using SPSS v. 19. Pearson chi-square test and Fisher exact test were performed where appropriate to test the associations between categorical variables, while the Mann-Whitney U test was used to compare continuous variables. The level of significance was taken as $p \leq 0.05$.

Results

Clinical characteristics of SSc patients

An ethnic composition of Chinese (45.2%), Malay (38.7%), and Indian (16.1%) was observed. The demographic and clinical characteristics of our cohort were very similar to those of other larger studies published in the literature. Female to male ratio was 9:1. Raynaud's phenomenon was seen in 26 (83.8%) patients and lung fibrosis in 22 (70.9%) patients. Eight (25.8%) patients had digital ulcers while 15 (48.3%) patients had calcinosis at the time of assessment. Ten (32%) patients had anti-Scl 70 antibody while five (16%) were positive for anti-centromere antibody. Table I outlines the demographic and clinical characteristics of the cohort.

The upper GI symptoms reported in this cohort were mainly related to GORD and oesophageal dysmotility. Overall, 25 (80.6%) patients had symptoms of GORD at the time of the study, mainly with symptoms of heartburn in 14 (45.1%) and regurgitation in 10 (32.2%). Dysphagia was reported in nine (29%) patients and only one patient had odynophagia (3.2%). Five out of the nine patients with dysphagia reported moderate to severe symptoms, with daily occurrence for more than 6 months. The reported heartburn and regurgitation were moderate to severe, occurring weekly and daily in nine patients. Atypical chest pain and epigastric pain were reported by five (16.1%) and six (19.3%) patients respectively. Only two patients had daily episodes of epigastric pain that was graded as moderate to severe. The symptoms of GORD were seen in 16 (72.7%) of the lcSSc and in all 9 (100%) of dcSSc patients. There was no association between gastroesophageal manifestations and SSc subtypes or the duration of disease.

High-resolution oesophageal manometry and 24-hour impedance-pH monitoring findings

Twenty-seven and 26 patients had high-resolution oesophageal manometry and 24-hour impedance-pH monitoring tests, respectively. Oesophageal

Table I. Demographic data and clinical features of the SSc patients. The data of baseline demographics are presented as mean±SD; SSc, systemic sclerosis; lcSSc, limited cutaneous systemic sclerosis; dcSSc, diffuse cutaneous systemic sclerosis; ACA, anti-centromere antibody; RNAP-III, ribonucleic acid polymerase-III; PDGFR, platelet-derived growth factor receptor; NOR, nucleolus-organising regions.

Baseline demographics	
Female, n (%)	28 (90%)
Age (years)	51 ± 12.8
Age at disease onset (years)	42 ± 13.4
Duration of disease (years)	8.8 ± 6.9 (range 7 months to 31 years)
Height (cm)	157 ± 7
Weight (kg)	56.5 ± 13.2
Body mass index (BMI) (kg/m^2)	23.2 ± 5.6
Subsets	
lcSSc	22 (71%)
dcSSc	9 (29%)
Clinical features (n=31)	
Raynaud's phenomenon	26 (83.8%)
Telangiectasia	12 (38.7%)
Digital ulcers	8 (25.8%)
Digital pad loss or pitting	14 (45.1%)
Calcinosis	15 (48.3%)
Arthritis	21 (67.7%)
Lung fibrosis	22 (70.9%)
Pulmonary arterial hypertension	18 (58%)
Renal crisis	1 (3.2%)
Heart conduction defects	4 (12.9%)
Use of proton-pump inhibitors	12 (41.9%)
Use of H_2 blockers	3 (9.7%)
Use of prokinetic agents	3 (9.7%)
Autoantibodies (n%)	
Anti-Scl-70	10 (32.2%)
Anti-Ro-52	10 (32.2%)
Anti-CENP-A (ACA)	2 (6.5%)
Anti-CENP-B (ACA)	3 (9.7%)
Anti-Fibrillarin (U3RNP)	3 (9.7%)
Anti-RP-11 (RNAP-III)	2 (6.5%)
Anti-RP-155 (RNAP-III)	2 (6.5%)
Anti-Ku	2 (6.5%)
Anti-PM-Scl-75	2 (6.5%)
Anti-PM-Scl-100	0
Anti-Th/To	0
Anti-PDGFR	0
Anti-NOR-90	1 (3.2%)

Table II. Results of oesophageal manometry and 24-hour pH monitoring tests. The data are presented as mean ± SD. LOS, lower oesophageal sphincter.

High resolution manometry with impedance (n=27)	
Hypotensive LOS, n (%)	17 (63%)
Oesophageal dysmotility, n (%)	24 (88.9%)
Coordinated peristalsis (%)	37.2 ± 35.1
Simultaneous peristalsis (%)	12.8 ± 20.8
Failed peristalsis (%)	50 ± 36.5
Distal wave amplitude (mmHg)	48 ± 35.5
Incomplete clearance (%)	17.2 ± 26.5
24-hour pH monitoring with impedance (n=26)	
pH <4 (%)	32.8 ± 28.9
Demeester score	117 ± 90
Total number of acid reflux	261 ± 221.3
Number of acid reflux	16.4 ± 29.9
Number of weakly acidic reflux	23.8 ± 37.4
Number of non-acidic reflux	3.3 ± 10

dysmotility with peristaltic impairment was detected in 24 (88.9%) patients with only eight (33.3%) experiencing dysphagia and/or odynophagia. Seven of 17 (41.2%) patients who had hypotensive LOS had digital ulcers, compared to none in the non-hypotensive LOS group (p=0.026). In the hypotensive LOS group, 12 of 17 (92.3%) patients had calcinosis while only 1 (7.7%) patient had calcinosis in the non-hypotensive LOS group (p=0.004). GORD was detected in 21 (84%) patients of whom 17 (81%) were symptomatic. Only six patients in this whole study cohort had previously undergone oesophagogastroduodenoscopy; five out of six demonstrated evidence of reflux oesophagitis. The frequency of oesophageal dilatation based on HRCT scan of the thorax was 11 out of 25 patients (44%). All SSc patients with oesophageal dilatation on HRCT scan had oesophageal dysmotility detected by manometry, while 75% had evidence of GORD from 24-hour pH study. No association between gastroesophageal manifestations and SSc autoantibodies was observed. Table II shows results of the high-resolution manometry and 24-hour pH impedance study.

The percentage of incomplete clearance of gastric contents was higher and the number of daily acid reflux episodes was significantly more frequent in those who had symptomatic GORD (p=0.038 and p=0.047, respectively). A Demeester score >200 was seen in six (24%) patients, with two patients having acid reflux that exceeded 600 over 24 hours. A Demeester score >200 was also likely to be observed in those with moderate to severe symptoms of heartburn and regurgitation that occurred up to daily (p=0.002). Eleven out of 12 patients (91.7%) with current medication of a proton pump inhibitor (PPI) had evidence of GORD and/or oesophageal dysmotility. All the patients on H_2 blockers and pro-kinetic agents had GORD and/or oesophageal dysmotility. Table III presents the objectively measured gastroesophageal clinical findings from manometry and 24-hour pH monitoring tests in SSc patients with and without gastroesophageal symptoms.

Association with internal organ involvement

Typical symptoms of GORD such as heartburn, regurgitation and dysphagia were common in SSc patients with pulmonary fibrosis. A majority of patients included in this study had pulmonary fibrosis. We found that pulmonary fibrosis was present in 13 out of 21 (61.9%) patients with objectively measured GORD. 17 out of 21 (81%) patients with FVC <80% or a restrictive lung pattern (FEV_1/FVC ratio >80%) had GORD. Significant association between the severity of gastroesophageal reflux and pulmonary involvement was observed. Patients with pulmonary fibrosis were significantly associated with daily number of acid reflux episodes >200 (p=0.030). A restrictive lung pattern was likely to present in those who had Demeester score >200 (p=0.001).

Discussion

Gastroesophageal reflux disease in SSc is related to motility impairment caused by smooth muscle cell damage and dysfunction of the LOS, as part of microvascular and fibrotic component pathophysiology, which eventually results in reflux of the gastric contents (12, 13). Therefore it is not surpris-

Table III. The objectively measured gastroesophageal clinical findings from oesophageal manometry and 24-hour pH monitoring tests in systemic sclerosis patients with and without gastroesophageal symptoms. $p \leq 0.05$ is considered statistically significant. LOS, lower oesophageal sphincter.

	Presence of heartburn			Presence of epigastric pain (dyspepsia)			Presence of regurgitation			Presence of dysphagia		
	No	Yes	p-value	No	Yes	p-value	No	Yes	p-value	No	Yes	p-value
Manometry, total number	14	13		21	6		17	10		19	8	
Oesophageal dysmotility, n (%)	14 (100%)	10 (77%)	0.098	20 (95%)	4 (67%)	0.115	14 (82%)	10 (100%)	0.232	16 (84%)	8 (100%)	0.331
Failed peristalsis >75%, n (%)	4 (29%)	7 (54%)	0.173	8 (38%)	3 (50%)	0.472	3 (17%)	8 (80%)	0.002	5 (26%)	6 (75%)	0.027
Hypotensive LOS, n (%)	9 (64%)	8 (62%)	0.598	13 (62%)	4 (67%)	0.613	11 (65%)	6 (60%)	0.563	12 (63%)	5 (63%)	0.651
24-hour pH study, total number	14	12		21	5		16	10		18	8	
Demeester score >200, n (%)	1 (7%)	5 (42%)	0.052	5 (24%)	1 (20%)	0.678	1 (6%)	5 (50%)	0.018	3 (17%)	3 (38%)	0.249
Acid reflux >200, n (%)	7 (50%)	6 (50%)	0.652	1 (57%)	1 (20%)	0.161	7 (44%)	6 (60%)	0.344	10 (56.%)	3 (38%)	0.336

ing that gastroesophageal manifestations are common and can present in almost all SSc patients, including both diffuse and limited cutaneous subsets. Gastroesophageal manifestations may lead to malnutrition, with risk increasing with disease severity (14). Patients with dcSSc have been observed to be more prone to significant visceral involvement affecting the gastroesophageal system (10, 15, 16). However in most of the studies, SSc subsets did not appear to have statistically significant association with the presence of oesophageal manifestations (17-19). Three quarters of the lcSSc patients and all of those with dcSSc subset were symptomatic for GORD in our cohort, while objectively measured GORD with oesophageal dysmotility was seen in all the study patients, except for one lcSSc patient.

Interestingly, we observed an association between the presence of digital ulceration or calcinosis and hypotensive LOS. In a recently published study, Bruni *et al*. demonstrated a significant association between digital ulcers (active as well as history of digital ulcer) and oesophageal manometry alteration in a population of very early SSc (VEDOSS) patients (20). The data demonstrated that patients in the VEDOSS study were already showing subclinical oesophageal involvement, where a microvascular component is prominent before fibrotic features. The authors suggested that digital ulcers in a VEDOSS patient might serve as a very early sign of possible internal organ involvement.

For reasons not well understood, even though gastroesophageal dysfunction is common, patients may not always be symptomatic. As oesophageal dysfunction has been demonstrated to present early in the course of the disease prior to symptoms (17), the symptoms themselves may not be present even in those with established SSc for years, due to desensitisation of the oesophagus caused by mucosal damage. This makes early diagnosis pivotal in preventing complications. Previous studies failed to demonstrate good agreement between symptoms and objective assessment of GORD. Standardised questionnaires for clinical symptoms could not distinguish patients with and without abnormal reflux, including in those with idiopathic pulmonary fibrosis (21-23). Nevertheless two recent studies demonstrated high sensitivity of the GI questionnaire tools for the diagnosis of GORD and upper GI involvement, but conferred a low specificity. In both studies, either oesophageal manometry or 24-hour pH monitoring was performed as part of the GI assessment, not both tests together (24, 25). Consistent with previous findings in several cohort studies (17, 26), we observed that significant proportion of the patients (66.6%) were asymptomatic in confirmed oesophageal dysmotility. Approximately one in five patients was asymptomatic in proven GORD by 24-hour pH monitoring with impedance. As outlined in Table III, the main upper GI symptoms such as heartburn, dyspepsia, regurgitation or dysphagia can be absent in majority of the SSc patients including those with severe gastroesophageal manifestations demonstrating failed peristalsis >75%, hypotensive LOS, Demeester score >200 and acid reflux >200 per day. The lack of correlation between symptoms and severity of GORD and oesophageal dysmotility suggests that formal evaluation with oesophageal manometry and 24-hour pH study would complement assessment of upper GI.

Similar to other studies, heartburn, regurgitation and dysphagia were the most frequent upper GI symptoms in our cohort (27, 28). Some differences and similarities of findings were observed in our study compared to previous data. We did not find correlation between severity of acid reflux and oesophageal dysmotility measured objectively (eg. Demeester score >200 vs failed peristalsis of >75%). The observation was in contrast with the report from Yarze *et al* that demonstrated significance in excessive acid exposure in the distal oesophagus of SSc patients without oesophageal peristalsis (29). Similar to previous study findings by Bassotti *et al*., our study found no correlation between oesophageal symptoms and the severity of manometric abnormalities (16). These results suggest that symptoms are not reliable in predicting the seriousness of the oesophageal problems.

The relationship between gastroesophageal involvement and presence of pulmonary fibrosis is important and the hypothesis that gastroesophageal reflux as a major causative factor is favoured. Our patients with pulmonary fibrosis had more severe reflux disease compared to those without pulmonary fibrosis. This result is concordant with previous published data that demonstrated pulmonary fibrosis was associated with more severe oesophageal dysfunction and acid exposure (30, 31). In addition, non-acidic reflux reaching the proximal oesophagus was also significant in SSc patients with pulmonary fibrosis (31). A recent study from a large Canadian cohort demonstrated that oesophageal dysmotility symptoms were associated with worsening FVC in SSc (32). Another study documented that at 2-year follow-up, SSc patients with severe oesophageal motor disturbances had faster deterioration of lung function and high frequency of pulmonary fibrosis on high-resolution CT (HRCT) scan, compared to those without (30). Despite the positive findings, one recent systematic review concluded that a causal relationship between reflux and pulmonary fibrosis could not be established (33, 34). Interestingly, a novel histological pattern of the lung called centrilobular fibrosis (CLF) has been described and can be present in isolation or together with the more classic type of NSIP (35). Reflux and chronic aspiration of gastric contents into the lung is thought to play an important role as more than 50% of the cases with isolated CLF had predominant central injury with patchy distribution of ground glass opacities and consolidations on HRCT scan. This group of patients had oesophageal dilatation of more than 4 cm and high prevalence of oesophageal dysmotility and/or oesophagitis (35). The fact that GORD and pulmonary fibrosis often co-exist in patients with SSc and that the patients with pulmonary fibrosis have higher incidence of reflux disease, suggests that GORD could contribute to the natural history of pulmonary fi-

brosis. In addition to recurrent microaspirations as a contributing factor to the development of pulmonary fibrosis, the occurrence of both severe reflux and pulmonary fibrosis could also simply reflect a more advanced stage of the disease.

Although the sample size was small, we did a detailed assessment, including subjective symptoms and objective findings from two tests; providing robust data on oesophageal disease in SSc patients. We did not use validated questionnaires for the GI questions but the self-reported upper GI symptoms by our patients during our routine clinical care had similar domains. We used high resolution manometry which has the advantage of evaluating the oesophageal peristaltic and sphincter function better compared to conventional manometry, and improving diagnostic accuracy. The use of reflux monitoring with pH impedance in our study compared to conventional pH studies has the advantage of measuring the composition of intraoesophageal contents including liquid and gas contents; and the ability to detect weakly acid and non-acidic reflux events, in addition to breakthrough acid reflux, where PPIs tend to increase the gastric pH (36). Our data showed that the characteristics of our patients were representative of the general SSc population as reported in other larger studies. Our patients had different disease duration, with varying degree of oesophageal manifestations; therefore our study is not able to prove if adequate treatment of GORD changes the severity of gastroesophageal manifestations and the natural history of pulmonary fibrosis. Future work including a longitudinal cohort study following patients at the same stage of disease and repeat assessments is warranted.

In conclusion, gastroesophageal manifestations are common in SSc patients. While largely consistent with studies of other SSc populations, some unique features were observed from our data, including association between digital ulcer and hypotensive LOS. The present study confirms that main gastroesophageal symptoms can be absent in a good proportion of SSc patients including in those with objectively measured severe gastroesophageal manifestations. In addition, severity of GORD may contribute to pulmonary fibrosis suggesting that aspiration precautions should be emphasised with aggressive treatment of GORD. Oesophageal manometry and 24-hour pH study should therefore be considered more frequently in the assessment of SSc patients.

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