Evaluation of the gastrointestinal tract in juvenile systemic sclerosis: the paediatric gastroenterologist perspective

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ABSTRACT

The gastrointestinal (GI) tract is one of the most affected organs in systemic sclerosis (SSc), described in 42-78% of children with juvenile-onset SSc (jSSc). GI disease negatively impacts quality of life and increases disease-specific morbidity and mortality. Immune-mediated vascular, mucosal and neuromuscular compromise of the GI tract results in heterogeneous disease and variable clinical symptoms, severity, and disease progression. The burden of GI disease has a significant impact on clinical outcomes, and yet diagnosis and monitoring of GI disease remain challenging. The problem is multifactorial and includes symptoms that are non-specific and often overlooked, poor correlation between GI symptoms and testing, and limitations of GI-specific diagnostic testing. This review describes the clinical presentation and diagnostic work-up of upper and lower GI disease in jSSc via three distinct clinical scenarios, each encompassing a different segment of the GI tract (oropharynx/oesophagus, stomach/small bowel, colon/anorectum). Specifically, it highlights that the assessment of GI disease in jSSc warrants a high level of suspicion, timely evaluation, proper diagnostic testing, and most notably multidisciplinary collaboration.

Introduction

The GI tract is one of the most affected organs in children and adults with systemic sclerosis (SSc) (1-4). Vasculopathy, immune-mediated inflammation, and neuropathy of enteric nervous system, result in muscle atrophy and fibrosis that culminate in GI dysmotility and dysfunction (1, 5). GI involvement has been reported in up to 90–95% of adults (5-9) and 42–78% of children with SSc (3, 10-15). The burden of GI disease in jSSc has not been fully elucidated. The literature is sparse, and GI disease has variable clinical presentation, disease severity, and progression in children and adults with SSc (1, 16). Despite its limited footprint in the literature, GI disease has a significant impact on quality of life, morbidity, and mortality of children and adults with SSc (3, 17-23). GI disease in SSc can evolve and progress over time (14, 19, 20), negatively affecting health-related quality of life (HRQoL) (1), social functioning and emotional well-being (22), and overall physical and mental health (24). GI involvement is also associated with malnutrition (3, 15, 19, 23, 25). In their multinational Childhood Arthritis and Rheumatology Research Alliance (CARRA) Legacy Registry, Stevens *et al*. reported that 28% of their jSSc cohort had malnutrition, with notably half (14%) demonstrating moderate to severe malnutrition (3). Stefancic *et al*. used the University of California Los Angeles Scleroderma Clinical Trials Consortium Gastrointestinal Tract 2.0 (UCLA GIT 2.0) questionnaire to show that 23.5% of their University of Pittsburgh jSSc cohort reported weight loss (15). In adults with SSc, malnutrition lowers quality of life (26, 27) and is associated with increased morbidity (27) and mortality (28-30). Given the potential impact of GI disease on growth and development, nutritional evaluation is paramount (4, 31).

Recognising the signs and symptoms of GI disease in SSc is challenging. in the CARRA Legacy Registry children with GI disease had the lowest patient-reported global well-being scores, yet the physician global assessments underestimated their GI disease burden (3). GI symptoms are usually non-

specific and can be otherwise silent in asymptomatic patients, therefore these symptoms are typically overlooked or dismissed without further diagnostic inquiry. Notably, there is a poor correlation between symptoms and objective findings on GI testing (5, 7, 32, 33). Medications for SSc can also cause GI side effects that mimic common GI disorders such as nausea, reflux, and diarrhoea (7, 34). These pose a significant challenge for diagnosis and monitoring of GI disease. To date, there are no validated paediatric questionnaires to assess GI symptoms in jSSc. However, a recent study by Stefanicic *et al*. used the UCLA GIT 2.0 to characterise GI symptoms in their paediatric jSSc cohort and demonstrated its acceptable validity and sensitivity to change (15).

Assessment of children with jSSc warrants a high level of suspicion for underlying GI disease and requires timely evaluation, diagnostic testing, and multidisciplinary collaboration (9). This review highlights the challenging landscape and diagnostic pathways in the evaluation of a child with jSSc, through three distinct clinical scenarios, each focused on a different GI segment.

Evaluation of upper GI symptoms: oropharynx and oesophagus

Case: A 10-year-old female with jSSc is referred for 6 months of progressive dysphagia and heartburn. Solids and liquids stick in her mid-chest, with regurgitation, coughing at meals, and nocturnal retrosternal burning that is poorly relieved by antacids. She has lost 3 kg and now avoids meat and bread. Examination shows sclerodactyly, perioral tightening with reduced mouth opening and dry mucous membranes.

Her symptoms reflect two commonly affected upper GI compartments. At the oropharyngeal level, a reduced oral aperture and impaired pharyngeal clearance increase the risk of aspiration (35). In the oesophagus, smooth muscle fibrosis produces aperistalsis and a hypotensive lower oesophageal sphincter (LES), promoting gastroesophageal reflux (5).

Upper GI involvement, especially the oesophagus, occurs in up to 90% of adults with SSc and can arise at any stage of disease (5, 7). In children with jSSc, oesophageal dysmotility is also common but often under-recognised. (3) In a registry of 51 children with jSSc, over 70% reported reflux symptoms despite only mild overall burden on UCLA GIT 2.0 scores (15). Importantly, symptoms correlate poorly with underlying pathology (5), and esophagitis may be entirely asymptomatic (7). A symptom-driven approach alone can therefore miss clinically significant disease.

For this reason, objective evaluation may be considered at the time of diagnosis as a staging strategy, rather than waiting for symptoms to develop. Up to 84% of asymptomatic adults have dysmotility on high-resolution oesophageal manometry (HREM), and impaired baseline motility predicts future symptomatic disease (hazard ratio 2.3) (36). HREM is particularly useful for risk stratification in adults with diffuse cutaneous disease, digital ulcers, or reduced diffusing capacity of the lungs for carbon monoxide (DLCO) (36, 37). Absent contractility also carries prognostic significance, with associations to lung transplantation and SSc-related mortality in adults (37).

Some experts supports early gastroenterology referral for adults with SSc, even in the absence of symptoms (38). Early endoscopy may detect otherwise unrecognised esophagitis (39), and abnormalities on fluoroscopic oesophagram or chest computed tomography (CT) should prompt closer pulmonary monitoring (40). Symptom burden can be followed using the UCLA GIT 2.0 questionnaire, which was recently studied in jSSc (15). Its reflux scale is sensitive but not specific, making it useful for screening but not a substitute for objective testing (5).

When symptoms are present, testing distinguishes a swallowing-safety problem from oesophageal dysmotility and reflux burden. An escalating sequence moves from videofluoroscopic swallow study (VFSS) and fluoroscopic eosophagram, to esophagogastroduodenoscopy (EGD) with biopsies, followed by physiologic testing with endoluminal functional lumen imaging Probe (EndoFLIP), HREM, and 24-hour pH-Impedance, as shown in Figure 1. Of note, EGD should be performed with attention to the increased procedural risk in SSc, where aspiration risk, pulmonary involvement, and microstomia can complicate sedation and endoscopic access (5). On oesophageal manometry, absent contractility and ineffective oesophageal motility are characteristic findings in SSc (41, 42).

A common management question is whether to initiate acid suppression empirically in all newly diagnosed patients with reflux symptoms or to pursue testing first. Starting a proton pump inhibitor (PPI) before endoscopy may mask mucosal disease, partially treat reflux oesophagitis, and reduce eosinophil counts, which can obscure eosinophilic esophagitis, a key cause of dysphagia in children (43). For this reason, mucosal evaluation is ideally performed before starting acid suppression or after tapering a PPI, favouring a strategy of baseline assessment with targeted therapy rather than empiric treatment alone.

Once structural, mucosal, and motility aetiologies are excluded (Table I), persistent symptoms should prompt consideration of disorders of gut-brain interaction (DGBI) according to the Rome V criteria (44). A recent cross-sectional survey using Rome IV diagnostic criteria to assess DGBI in adults with SSc reported functional dysphagia in 23% of adults with SSc (45).

Figure 1 consolidates this approach into a practical, symptom-directed algorithm for the child with jSSc and upper GI complaints. Because oesophageal disease may be silent, a baseline EGD can be considered at diagnosis even without symptoms. Three presenting phenotypes, dysphagia, regurgitation and heartburn, are then followed in parallel lanes. Predominantly solid-food dysphagia is evaluated structurally rather than with empiric acid suppression, and EGD is obtained before a PPI is started (or after tapering) when EoE is suspected, to avoid masking mucosal disease (43). Regurgitation and heartburn begin with a defined PPI trial; failure to respond triggers endoscopy and, once structural and mucosal causes are excluded, symptom-directed physiologic testing with HREM, End-

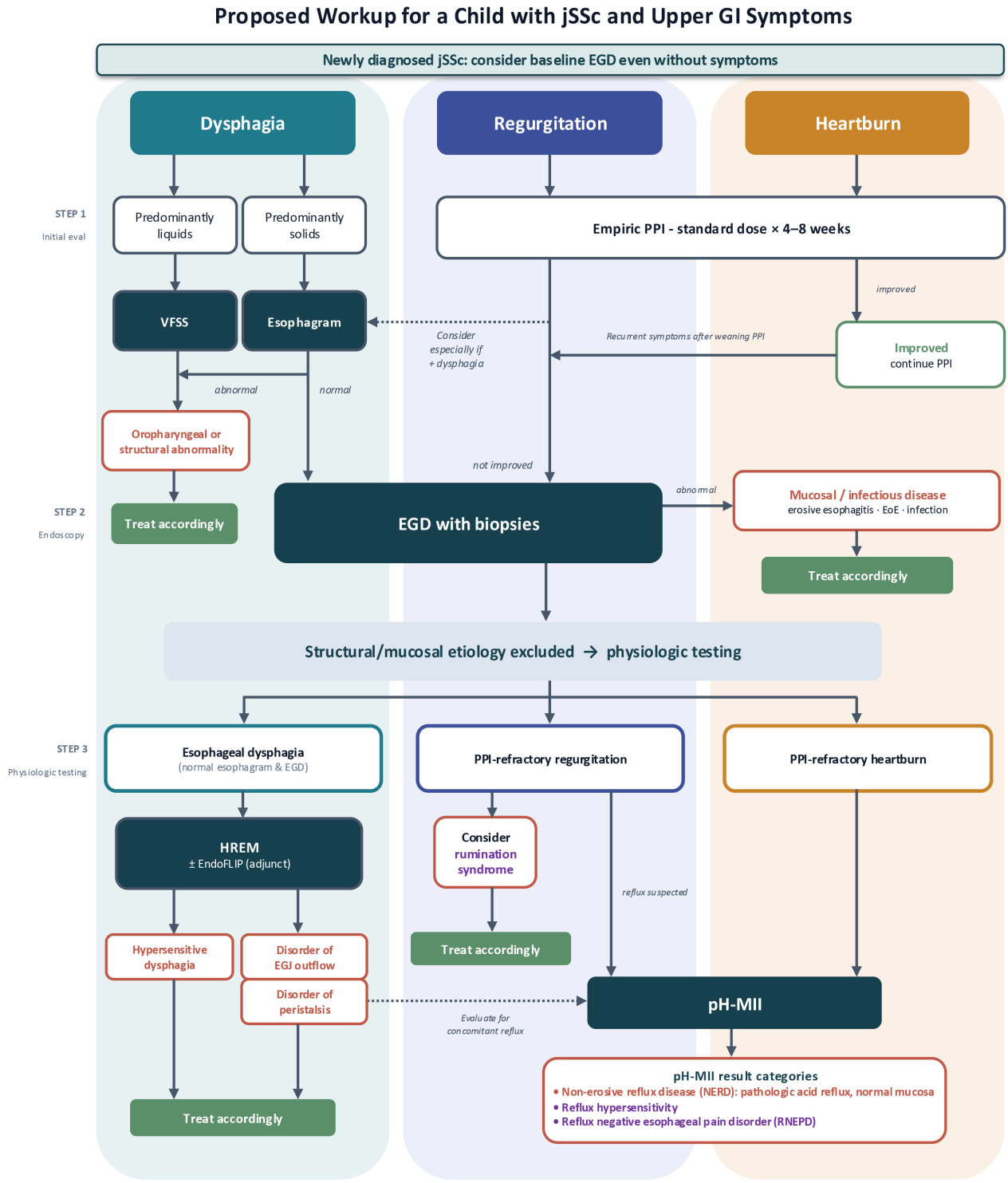

Fig. 1. Proposed workup for a child with juvenile systemic sclerosis (jSSc) and upper gastrointestinal (GI) symptoms.
At the time of a new diagnosis, a baseline EGD may be considered even in the absence of symptoms. Three common presenting phenotypes, including dysphagia, regurgitation and heartburn, are each followed downward through initial evaluation, endoscopy, physiologic testing, diagnosis and management. Solid-food dysphagia is assessed structurally rather than with empiric acid suppression; when eosinophilic esophagitis or dysphagia is suspected, EGD is obtained before starting a PPI or after tapering, to avoid masking mucosal disease. After structural and mucosal causes are excluded, each lane proceeds to symptom-directed physiologic testing. Hypersensitive dysphagia, rumination syndrome, and the pH-MII categories (NERD, reflux hypersensitivity, RNEPD) are classified as Rome V disorders of gut–brain interaction. Management is directed at the underlying mechanism: PPI with reflux precautions, plus an H2RA for nocturnal symptoms or an alginate for postprandial reflux for confirmed reflux, and a prokinetic such as prucalopride for oesophageal dysmotility.
EGD: esophagogastroduodenoscopy; EGJ: esophagogastric junction; EndoFLIP: endoluminal functional lumen imaging probe; EoE: eosinophilic esophagitis; GI: gastrointestinal; H2RA: histamine H2-receptor antagonist; HREM: high-resolution oesophageal manometry; jSSc: juvenile systemic sclerosis; NERD: non-erosive reflux disease; pH-MII: pH-multichannel intraluminal impedance; PPI: proton pump inhibitor; RNEPD: reflux-negative oesophageal pain disorder; SSc: systemic sclerosis; VFSS: videofluoroscopic swallow study.

oFLIP, and pH-impedance. Persistent symptoms are then classified as Rome V DGBI (including reflux hypersensitivity, functional heartburn, and rumination) and management is matched to the confirmed mechanism, from reflux precautions and acid suppression to a prokinetic for dysmotility (5, 44).

In this patient, the workup confirmed oropharyngeal dysphagia with aspiration risk, biopsy-proven distal esophagitis, an aperistaltic oesophagus with an incompetent esophagogastric junction, and pathologic reflux. Management combined acid suppression and reflux precautions with speech-language and nutrition support for the oropharyngeal phase. Care was coordinated with rheumatology, given that oesophageal severity mirrors systemic disease (46).

Evaluation of upper GI symptoms: stomach and small bowel

Case: A 10-year-old male with diffuse jSSc, of 3 years' duration reports 6 months of worsening postprandial bloating, nausea, and occasional vomiting. His weight has declined from the 50th to the 25th percentile over 12 months. He has missed fifteen school days from morning nausea and feeling "too full" to eat lunch at school.

This child's weight decline with nausea, vomiting, and bloating is concerning for upper GI involvement. Gastric and small-bowel involvement is heterogeneous and has been reported in up to 88% (2, 8, 47) of adults with SSc. In the Pittsburgh registry of 51 children with jSSc who completed the UCLA GIT 2.0 questionnaire, over 70% of patients reported symptoms of distention, bloating, and reflux, with nearly a quarter demonstrating weight loss (15). Similarly, 28% of the jSSc cohort within the CARRA Legacy Registry had malnutrition and half (14%) met criteria for moderate to severe malnutrition (3). The prevalence of malnutrition in adults with SSc ranges from 16.2% to 62.5% (48) and is associated with increased likelihood of GI involvement and increased morbidity (23, 49). Notably, there is a high rate of zinc, copper, and vitamin D deficiencies (50). Bader *et al*. reported patients with GI disease were nearly uniformly malnourished, with up to 13-fold higher mortality (51). Comprehensive nutritional evaluation and close monitoring of nutritional parameters, including vitamins and micronutrients, in jSSc are strongly recommended (4, 31).

Recognition and timely evaluation of upper GI disease is essential as early GI symptoms and increased symptom burden predict progression of GI disease and mortality (52). In a multinational cohort of 134 patients with jSSc, early signs of internal organ involvement, particularly GI, were associated with poor outcomes (53). The initial evaluation of a child with jSSc and suspected upper GI involvement warrants a detailed history and examination. Alarming signs and symptoms include dysphagia, early satiety, vomiting, abdominal distention, weight loss, need for nutritional supplementation, recurrent obstructive episodes, diarrhoea, and bloody stools. The initial work-up can be challenging due to both the poor correlation between symptoms and GI pathology and the scarcity of paediatric data (33, 54). Adult studies consistently show early endoscopic changes regardless of symptoms (39, 55). An EGD is a useful initial diagnostic step in the evaluation of upper GI symptoms in children with jSSc. (56) Gastric and small bowel disease in SSc may present as mucosal pathology (inflammation, ulceration, or vasculopathy) or as a motility disorder (gastroparesis, small intestinal bacterial overgrowth [SIBO]/malabsorption, or chronic intestinal pseudo-obstruction) (Table I). It is also important to consider other common GI disorders such as infections, gastric or duodenal ulcers, gastritis, hiatal hernia, celiac disease, and others (57, 58).

Iron deficiency anaemia warrants particular attention given its association with gastritis (35–90%), gastric ulcers (13%), gastrointestinal malignancies, Gastric Antral Vascular Ectasia (GAVE), and small-bowel vasculopathies. (45, 57, 59, 60). Although uncommon, GAVE can cause unexplained iron deficiency anaemia and appears to occur more frequently in patients with anti-RNA polymerase III antibodies (61, 62). Reported prevalence ranges from 0% to 22.3%, and presentation is typically chronic iron deficiency anaemia rather than overt GI bleeding (63-65). GAVE lesions appear to improve after immunosuppressive therapy. While an EGD remains the initial test for unexplained anaemia, capsule endoscopy may provide complementary diagnostic value to identify small bowel vasculopathy. Marie *et al*. reported abnormal small bowel findings in 26% of adult SSc patients, 46% of whom had normal gastroscopy (66).

Common upper GI symptoms such as postprandial bloating, nausea, vomiting, and weight loss may be the presenting symptoms of underlying GI dysmotility. Adults and children may develop gastroparesis, chronic/paediatric intestinal pseudo-obstruction (CIPO/PIPO), and resultant SIBO and malabsorption (5, 58).

Gastroparesis is highly prevalent and reported in up to 38–50% of SSc patients (2, 58). The clinical presentation of gastroparesis in SSc is often non-specific, where symptoms of bloating and abdominal distension are more common than nausea, vomiting, and early satiety (67). The gold standard for evaluating gastric emptying is a 4-hour solid-phase gastric emptying study (GES) (68). When GES is unavailable or poorly tolerated, the 13C-spirulina or the 13C-octanoic acid breath tests represent acceptable alternatives with good diagnostic performance (68, 69). The breath tests are radiation-free and non-invasive, and 13C-spirulina has been validated in paediatrics (70). Importantly, gastric dysmotility rarely occurs in isolation. Adler *et al*. found 91% of patients with delayed gastric emptying had evidence of GI dysmotility affecting other regions (71). Because of the high likelihood of diffuse GI dysmotility, whole-gut scintigraphy may provide a more comprehensive assessment of disease burden throughout the GI tract. However, this is limited by cost, radiation, centre availability, and expertise.

Chronic/paediatric intestinal pseudo-obstruction (CIPO/PIPO) has been reported in 5.4-6.2% of adult and 2.3% of juvenile patients with SSc (2, 58, 72). Abdominal pain and distension, nausea, vomiting, abnormal bowel habits

GI Region	Diagnoses	Presentation	Diagnostic tests
Esophagus			
Anatomy	Esophageal Stricture Esophageal Dilatation	Feeding difficulties, heartburn, nausea, vomiting, regurgitation, cough with meals or at night, nocturnal symptoms (choking, gagging, sleeping reclined), worsening pulmonary symptoms, weight loss	Esophagram VFSS EGD
Mucosa	Esophagitis Barrett's esophagus		EGD pH-MII
Motility	Esophageal Dysmotility (abnormal peristalsis, low LES pressures)		HREM +/- EndoFLIP
Gastric			
Mucosal	GAVE	Iron deficiency anemia, occult bleeding	EGD
	Gastritis	Abdominal pain, nausea/vomiting Nonspecific	
	Duodenitis	Abdominal pain, nausea/vomiting Nonspecific	
	Gastric Ulcers	Abdominal pain, nausea/vomiting Nonspecific	
	Gastric angiodysplasias	Anemia, occult bleeding	
Motility	Gastroparesis	Bloating, abdominal distension, nausea and vomiting, early satiety, weight loss	Gastric Emptying Study, 13C-Spirulina, 13C-Octanoic acid breath tests, ADM
Small bowel			
Mucosa	Small bowel telangiectasias	Anemia, occult bleeding	Capsule endoscopy
	Small bowel angiodysplasia	Anemia, melena	Capsule endoscopy
Motility	SIBO	Bloating, abdominal distention, diarrhea, weight loss, flatulence	Hydrogen (lactulose or glucose) or methane breath test
	PIPO	Recurrent non-mechanical obstructions, nausea, vomiting, abdominal distention and/or pain, bloating, weight loss	AXR CT/MRI Scintigraphy ADM
Colon			
Anatomy	Wide-mouthed colonic diverticula	Anemia Occult bleeding Hematochezia	AXR, CT Colonoscopy
	Colonic Dilation, Loss of Haustra	Constipation Fecal Impaction	AXR, CT
Mucosa	Colonic telangiectasias	Anemia, occult bleeding, hematochezia	Colonoscopy
	Stercoral Ulcers (chronic fecal impaction, fecaloma)	Anemia, occult blood loss, hematochezia, abdominal pain, constipation, fecal impaction, pain with defecation	AXR, CT +/- Colonoscopy
	Pneumatosis intestinalis	Abdominal distention and/or pain, blood in stool, nausea/vomiting,	AXR, CT
Motility	Slow colonic transit Colonic dysmotility Colonic atony	Constipation Fecal impaction Fecal incontinence	Radiopaque marker study Colonic Scintigraphy Contrast Enema Colonoscopy Colonic Manometry
Anorectum			
Mucosa	Stercoral Ulcers (chronic fecal impaction, fecaloma)	Anemia, occult blood loss, hematochezia, abdominal pain, constipation, fecal impaction, pain with defecation	AXR, CT +/- Colonoscopy
Motility	Anorectal Neuropathy Internal Anal Sphincter Atrophy Rectal Prolapse	Constipation Fecal incontinence Tenesmus Pain with defecation	Anorectal Manometry Balloon Expulsion Testing MR defecography

Table I. Gastrointestinal involvement in systemic scleroderma.
ADM: antroduodenal manometry; AXR: abdominal x-ray; PIPO: paediatric intestinal pseudo-obstruction; CT: computed tomography; EGD: esophagogastroduodenoscopy; EndoFLIP: endoluminal functional lumen imaging probe; GAVE: gastric antral vascular ectasia; HREM: high-resolution esophageal manometry; LES: lower esophageal sphincter; MR: magnetic resonance; MRI: magnetic resonance imaging; pH-MII: pH-multichannel intraluminal impedance; SIBO: small intestinal bacterial overgrowth; VFSS: videofluoroscopic swallow study.

(diarrhoea or constipation), and weight loss are common presenting symptoms, with malnutrition and dependence on total parenteral nutrition developing in advanced GI disease. Antroduodenal manometry (ADM) is used to evaluate gastric and small bowel motility, specifically in patients with suspected PIPO (73). A recent systematic review of nine studies using manometry reported a median prevalence of 87.5% for small bowel motor abnormalities in adults with SSc (74). ADM can distinguish between neuropathic patterns, which tend to predominate early in disease, from myopathic patterns, which are associated with more advanced disease (38, 75). While this information may influence therapeutic decision-making, current evidence has not demonstrated improved clinical outcomes resulting from manometry-guided management (73, 74).

Gastric and small bowel dysmotility predispose to SIBO, leading to subsequent malabsorption and malnutrition (2). Clinical manifestations may be subtle or nonspecific, such as abdominal distention and bloating, diarrhoea, weight loss, and micronutrient deficiencies (58, 74). Although jejunal aspirate culture obtained by EGD remains the gold standard for diagnosing SIBO, its invasive nature and practical challenges limit routine use. Methane and hydrogen breath testing with glucose or lactulose offers a widely available, non-invasive alternative to identify patients who may benefit from treatment (5, 76).

Finally, not all GI symptoms in jSSc are attributable to structural, mucosal, or motility pathology. In a recent cross-sectional survey of 101 adults with SSc, over 20% met Rome IV criteria for DGBI, specifically functional dyspepsia (21%), postprandial distress syndrome (21%), and irritable bowel syndrome (19%) (45). Moreover, patients with DGBI symptoms had more severe GI disease as measured by UCLA GIT 2.0 (45). This study highlights the importance of maintaining a broad differential diagnosis when evaluating persistent GI complaints in this complex population.

In this patient, the EGD demonstrated biopsy-proven *H. pylori* gastritis. Management combined treatment of *H. pylori* and nutrition evaluation. Patient was followed closely to assess for symptom improvement and weight monitoring.

Evaluation of lower GI symptoms: colon and anorectum

Case: A 16-year-old female with diffuse jSSc diagnosed 6 years ago is referred for constipation. She has had intermittent difficulty passing since early childhood with worsening symptoms over the past year. She has 2-3 bowel movements per week that are hard and associated with straining and a feeling of incomplete evacuation. She denies abdominal pain, distention, diarrhoea, blood or mucus in stool, weight loss, and faecal incontinence or stool leakage.

Colonic disease

The colon is affected in 10-50% of adults with SSc (2, 17, 47, 77). Patients with colonic involvement may present with diarrhoea, constipation, or gastrointestinal bleeding. While studies in children are limited, constipation and/or diarrhoea have been reported in 10-13.7% of children with jSSc (14, 15).

In jSSc, neuromuscular compromise and fibrosis of the colon can lead to functional and morphological changes such as slow transit, abnormal colonic motility, colonic atony, and dilation (2, 17). Patients may develop chronic constipation, faecal impaction, colonic pseudo-obstruction, and colonic wide-mouthed diverticulosis (2, 17, 32, 77) (Table I). Their clinical course can be complicated by stercoral ulceration, megacolon, volvulus and obstruction, and perforation (17, 32, 78).

Vasculopathy and vascular mucosal disease can lead to GI bleeding from rectal, colonic, or small bowel telangiectasias (most common), wide-mouthed colonic diverticula, and stercoral ulcers from chronic faecal impaction (17, 32, 77). Presentation may vary from iron-deficiency anaemia to overt haematochezia (58, 77, 79). Patients with unexplained iron-deficiency anaemia or lower GI bleeding warrant EGD and colonoscopy for mucosal disease.

The literature on colonic involvement in jSSc is sparse, with constipation as the most common lower GI symptom (14, 15). While constipation can be a sequela of GI disease in SSc, it must be emphasised that functional constipation is a prevalent DGBI in paediatric patients (80). A detailed clinical history, thorough physical examination, and Rome V diagnostic criteria should be used to diagnose functional constipation in children (81). Given the risk of colonic disease, children with jSSc should be followed closely and monitored for alarming signs and symptoms such as bloody stools, diarrhoea, abdominal distention, weight loss, nausea, vomiting, constipation refractory to therapy, or recurrent faecal impactions. Diagnostic testing for constipation is reserved for children who are refractory to medical therapy and/or exhibit alarming signs and symptoms concerning for colonic disease due to GI progression.

In adults with SSc, loss of haustra, colonic dilation, and colonic diverticula have been described on abdominal radiographs, fluoroscopic contrast enema, and abdominal/pelvic CT scans (2, 17, 77). Abdominal radiographs and fluoroscopic contrast enema can be used in children to evaluate colonic anatomy and calibre. Slow colonic transit has been demonstrated using colonic transit studies in adults with SSc (2, 5, 17, 32, 77). Radiopaque marker study (ROM) and colonic scintigraphy can be used to evaluate colonic transit. Compared to colonic scintigraphy, ROM study is simple to perform, well tolerated by children, and generally readily available (82). Conversely, colonic scintigraphy is limited by cost and centre availability (82). Notably, both transit studies lack validated paediatric protocols and normative paediatric data. Colonic manometry is the gold-standard test to evaluate the neuromuscular integrity of the colon and characterise colonic dysmotility (83).

Diarrhoea is commonly reported in patients with SSc. In adults with SSc, diarrhoea can be secondary to small intestinal dysfunction (2, 32, 77, 78, 84), leading to malnutrition from SIBO, carbohydrate (lactose, fructose) malabsorption, and bile acid malabsorption. Diarrhoea has also been reported in adults who have "overflow" stools and

incontinence from stool stasis secondary to colonic dysmotility and CIPO (2, 77). Mucosal diseases (including inflammatory bowel disease and microscopic colitis) have also been reported in adults with SSc (17, 32). However, given the shared pathophysiology of autoimmune dysregulation, this relationship is not necessarily considered causal (17, 32).

Childhood diarrhoea is common with a broad differential diagnosis, thus requiring a methodical history and evaluation to avoid unnecessary and invasive testing. Duration of diarrhoea (>2-4 weeks) and the presence of alarming signs and symptoms should prompt a timely evaluation and diagnostic work-up. Concerning signs and symptoms include weight loss, recent antibiotic use, blood or mucus in stool and associated abdominal pain, vomiting, fevers, or abdominal distention.

Laboratory testing should include electrolytes, renal function, complete blood count, inflammatory markers (ESR, CRP), albumin, iron studies, and celiac/thyroid studies if indicated (32). Infectious aetiologies should be excluded before malabsorption testing (alpha-1-antitrypsin, reducing substances, pH, faecal elastase) with EGD and colonoscopy reserved for select patients (2, 32, 77).

Anorectal disease

The anorectum is affected in 40-70% of adults with SSc (2, 5, 18, 32, 77, 78). Neuromuscular and morphological changes of the anorectum can lead to neuropathic and structural compromise of the internal anal sphincter, which plays a central role in continence (2, 18, 85-87). Patients with anorectal involvement commonly present with faecal incontinence (FI) and may have rectal prolapse, tenesmus with difficulty and pain during defecation (1, 2, 18, 58, 77) (Table I). Underlying colonic disease, such as constipation or diarrhoea, can compound the severity of FI (2, 17, 77). Prevalence of anorectal disease in children with jSSc is not known. Stefancic et al. reported a low faecal soilage domain score on UCLA GIT 2.0 but did not provide the number of children who reported FI (15). In children with jSSc, new-onset FI, rectal prolapse, or tenesmus warrants a careful history and physical examination to evaluate for functional and organic causes. In contrast to adults, FI in children is more likely to be functional than organic in aetiology. FI is commonly presented as a sequela of longstanding constipation and stool retention (retentive FI) or without associated stool retention (non-retentive FI). Congenital or acquired conditions that affect the anorectum, anal sphincter complex, enteric nervous system, and the spinal cord can result in neurogenic bowel and faecal incontinence, and must also be considered (88). Alarming signs and symptoms include new or progressive neurologic symptoms, secondary urinary and faecal incontinence, and abnormalities in gait, reflexes, spinal and rectal examination (88). In the absence of alarming signs and symptoms, children with FI rarely need testing.

Children with jSSc who have ongoing symptoms concerning for anorectal involvement secondary to progressive GI disease should undergo diagnostic evaluation. It is important to ensure that the FI is not secondary to diarrhoea from underlying small bowel dysfunction and malabsorption. Anorectal manometry can be used to assess the voluntary and involuntary properties of the anorectum, including intra-anal pressures, characteristics of the recto-anal inhibitory reflex, and pelvic floor function (83). This test is feasible in children and has normative paediatric data; however, it is limited by centre availability. To date, there are no reports describing anorectal manometry findings in children with jSSc. Endoanal ultrasound has been used in adults with SSc and FI to characterise the morphological changes of the internal anal sphincter (2, 18, 86, 89); however, studies in children are lacking. Balloon expulsion testing and defecography are well-established and widely used in adults to evaluate defecation dynamics (82). Both studies lack validated paediatric protocols and normative data.

In this patient, the clinical history and physical examination revealed no alarming signs or symptoms. Her symptoms were consistent with functional constipation by Rome V diagnostic criteria. She was started on osmotic and stimulant laxatives and referred to pelvic floor therapy with close outpatient monitoring.

Addressing gap in paediatrics

Across every GI segment, the paediatric evidence lags well behind that of adults, and the gaps are both diagnostic and strategic. The true prevalence and incidence of oesophageal, gastric, small-bowel, colonic, and anorectal involvement in jSSc remain undefined, drawn from small, heterogeneous registries rather than prospective cohorts (3, 14, 15). Symptom assessment long lacked a paediatric-specific instrument; the UCLA GIT 2.0 was only recently validated in children, and physician global assessment underestimates GI burden (3, 15). Most diagnostic tools (HREM, EndoFLIP, GES, breath testing, colonic transit studies, balloon expulsion, and defecography) lack validated paediatric protocols, normative data, or disease-specific thresholds, thus diagnostic cutoffs and the prognostic weight of baseline dysmotility are extrapolated from adults (36, 37, 74, 82). Anorectal manometry has paediatric norms yet has never been reported in jSSc (83). The natural history of GI disease throughout childhood and the link between early involvement and long-term morbidity and mortality remain largely uncharacterised (52, 53). Therapeutic and monitoring strategies are likewise adult-derived, with paediatric guidance resting on expert consensus rather than evidence (4, 9, 47). Closing these gaps will require multicentre paediatric cohorts and prospective, standardised studies, ideally through collaborative networks such as CARRA (3, 4).

Conclusion

GI involvement in SSc is common and a significant cause of major morbidity, including malnutrition and impaired growth in jSSc, poorer quality of life, and mortality. Despite its prevalence, the identification of GI problems remains challenging due to variable clinical presentations, lack of correlation between symptoms and pathology, and the need for invasive testing to

identify many pathologies. Clinicians must have a high level of suspicion for underlying GI disease and be prepared to closely monitor for alarming signs and symptoms of advancing GI disease. Nutrition evaluation and monitoring are critical and can be viewed as a "window" into the patient's GI health. While timely diagnostic testing is invaluable, this must be balanced with the risks, benefits and limitations of the available testing. Furthermore, not all GI symptoms in jSSc are a manifestation of GI pathology. Clinicians must keep a broad differential diagnosis and consider DGBI a diagnostic entity if not a comorbidity.

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