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COEXISTENCE OF CONSTIPATION AND INCONTINENCE IN CHILDREN AND ADULTS

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Abstract

The coexistence of constipation and fecal incontinence has long been recognized in pediatric and geriatric populations, but is grossly underappreciated in the rest of the adult population. In children, functional fecal incontinence is usually associated with constipation, stool retention and incomplete evacuation, and is frequently allied to urinary incontinence. Pathophysiology of the incontinence is incompletely understood, although both in children and adults, it is thought to be secondary to overflow, while in adults it may also be related to pelvic floor dysfunction and denervation. Incontinence has an important impact on quality of life and daily functioning, and in children may be associated with behavior problems. The treatment of underlying constipation usually results in improvement in incontinence. This review broadly addresses the epidemiology and pathophysiology of coexistent constipation and incontinence in both children and adults, and also reviews clinical presentation and treatment response in pediatrics.

Keywords

functional fecal incontinence; constipation; children; adults; pelvic floor dysfunction

INTRODUCTION

Fecal incontinence is a common problem throughout life. The coexistence of fecal incontinence and constipation has been well characterized in children and the geriatric population, but it also occurs during adulthood. In this chapter we will review current concepts about fecal incontinence associated with constipation in both pediatric and adult populations.

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Conflict of interest statement

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COEXISTENCE OF CONSTIPATION AND INCONTINENCE IN CHILDREN

Constipation in children is common, affecting between 0.7 and 29.6% of the general population worldwide [1,2], and is frequently associated with fecal incontinence [3]. In pediatrics, fecal incontinence has been defined as the voluntary or involuntary passage of feces into the underwear or in socially inappropriate places, in a child with a developmental age of at least 4 years [4]. It has been suggested that in otherwise healthy children, fecal incontinence is secondary to ‘overflow’, and therefore results from the presence of constipation [4–6]. Though this is the most common cause, it has recently been recognized that otherwise healthy children can also have fecal incontinence without any evidence of fecal retention, a group categorized as ‘functional non-retentive fecal incontinence’ (FNRFI) [4,7,8]. Fecal incontinence in children also occurs in a variety of organic diseases like congenital malformations, or neurogenic problems like myelomeningocele, and in other conditions affecting the anorectum, anal sphincters, or the spinal cord [6,9,10]. The present chapter will focus only on functional fecal incontinence in relation to constipation [10,11].

In the literature, fecal incontinence in children is frequently described by the terms “encopresis” and “fecal soiling”, but given the different meanings that these terms have across different cultures, Rome III and The Paris Consensus on Childhood Constipation Terminology (PACTT) have favored the term ‘functional fecal incontinence’ [4,8], which will be used throughout this chapter.

Epidemiology of functional fecal incontinence in children

The exact prevalence of functional fecal incontinence associated with stool retention varies depending on the population studied. Functional fecal incontinence in children is a common problem, reported in 1–4% of school-aged children [4,9,12,13]. The reported prevalence among children 4 years of age was 2.8%, in those 7–8 years, it was 2.3% for boys and 1.3% for girls [14], and among 10–12-year-olds, 1.3% for boys and 0.3% for girls [15]. Later studies in Sweden and the Netherlands revealed that, respectively, 9.8% and 4.1% of 5–6 year olds and 5.6% and 1.6% of 11–12 year olds suffered from fecal incontinence at least once per month [16]. Recently, a study in a primary care clinic of 482 US children aged 4 to 7 years, reported a prevalence of 4.4%, with 95% having underlying constipation [17]. In another epidemiologic study in Sri Lanka, fecal incontinence was present in 2% of the general population, with 82% having it associated with constipation [13]. In this study, the highest prevalence was 5.4% in children 10 years of age. Fecal incontinence was more frequent in boys (78%, with a boy to girl ratio of 3.6:1), those exposed to recent school and family-related stressful life events, and those from lower social classes. These observations have also been made in other populations [18]. A much higher prevalence (15%) was also reported in obese children [19].

The prevalence of fecal incontinence is higher in patients that have been referred to a tertiary care center for evaluation of constipation. In children with medically diagnosed fecal impaction, incontinence was found in >85% [20], and studies performed to test different regimens for the treatment of childhood constipation report a prevalence of 59% [21] to 70% [22]. It can therefore be appreciated that the prevalence of fecal incontinence is influenced by the setting where the study was performed. In general, prevalence is lower in epidemiologic studies, higher in hospital-based studies, and much higher in pediatric gastroenterology-based studies.

Functional fecal incontinence in children can also be subclassified as either primary, in those children that have never been toilet trained, and secondary, in those in which the incontinence returns after successful toilet training [23]. The exact prevalence of the different types is not known, as the distinction is not usually made in most publications,

although in some studies it has been estimated that primary incontinence occurs in approximately 45 to 50% of the patients [23]. In those studies in which it has been reported, it has been suggested that the presence of secondary incontinence is associated with better response to treatment [23].

Pathophysiology

The pathophysiology of functional fecal incontinence related to constipation in children is not clear. Earlier theories of psychopathology in children with fecal incontinence have been replaced with the concept that the presence of functional fecal incontinence is an interaction of behavioral and physiological factors resulting in long-standing functional constipation with overflow incontinence [4,9,24–26]. The presence of fecal incontinence is so well accepted as being a result of stool retention, that even the new Rome III criteria for the diagnosis of functional constipation in children has one of the possible diagnostic characteristics as the presence of fecal incontinence greater than once per week [4].

The overriding theory suggests that fecal incontinence is the result of a large hard fecal bolus (owing to stool withholding or primary rectal dysfunction) leading to frequent soiling episodes [6,27]. Frequently cited contributing factors include severe early constipation, painful defecation, treatments involving anal manipulation, coercive toilet training practices and social stressors, which would all lead to stool-withholding, and stool retention or fecal impaction [12,28]. It is thought that fecal incontinence occurs mainly in the presence of fecal impaction, either as overflow diarrhea or as stool leakage from the rectum as feces approach the anus [29,30].

Anorectal function has been studied in children with fecal incontinence related to constipation, and multiple studies have documented a lack of correlation between anorectal manometry findings and the presence of functional fecal incontinence [31]. Most studies show normal anal sphincter function in those patients [31]. Abnormal sensory thresholds also do not seem to contribute, as abnormal sensory thresholds occurs only in a minority of patients [32–35]. The presence of dyssynergia (paradoxical contraction or non-relaxation of the external anal sphincter while attempting to defecate) can frequently be seen in patients with constipation with or without fecal incontinence [36]. However, it has been shown in multiple studies in children, that improving defecation dynamics is not related to response to therapy [36–38]. Recent studies using the barostat have shown that patients with severely increased rectal compliance had lower defecation frequency and higher frequency of fecal incontinence episodes [29,30]. However prospective studies that have followed changes in rectal compliance over time have failed to show a correlation between constipation recovery and improvement in rectal compliance and incontinence [29]. They found a lack of correlation between rectal compliance and fecal incontinence, noting that fecal incontinence was present in most treatment failures independently of the patients having a normal or abnormal rectal compliance, suggesting there may be other mechanisms that lead to the persistence of fecal incontinence after treatment [29].

Clinical characteristics

The reported frequency of fecal incontinence episodes in children varies depending on the studies. In a large cohort of 418 children with constipation, it was described that 90% had evidence of incontinence, with 84% having incontinence episodes more than 2 times per week, and 27% having episodes at night while sleeping [27]. In another large study 1.1% had accidents less than once per week, 7% once a week, 24% 2 to 3 times per week, 18% 4 to 5 times per week, 21% 6 times per week to daily, and 41% more than once a day [15]. In many studies for the treatment of functional fecal incontinence, the mean number of

accidents per day is >1 [36]. Functional fecal incontinence in children usually occurs during the day, often after school in the afternoon [6].

Given that the fecal incontinence is secondary to stool retention in the majority, it is logical that a variety of symptoms of constipation have been associated with its presence. In particular, children with fecal incontinence have been described as having infrequent bowel movements, painful defecation, large bulky stools, and retentive posturing [12,17,18,23]. They also have frequent abdominal pain [13]. In a recent epidemiologic study of non-selected patients with fecal incontinence, 80% had large diameter stools, 77% had retentive posturing, 75% painful defecation, 75% straining, and 55% blood in the stool [13].

Children with fecal incontinence have also been shown to have poor quality of life, poor self-esteem and social withdrawal, features that usually disappear after successful treatment [4,9]. It has also been shown that children with fecal incontinence may have behavior problems, although it is not known if these are the cause or the result of the incontinence [39]. In a recent Dutch study, it was shown that the prevalence of behavioral problems in children with functional constipation is 3–4 fold higher compared with a general pediatric population, and that the frequency of fecal incontinence was associated with externalizing problems when using the Child Behavior Checklist [39]. It was suggested that the higher the frequency of incontinence episodes, the higher the rate of externalizing behavior problems. They found no relationship between the presence of fecal incontinence and internal behavior problems [39]. In other studies, behavioral problems before the start of treatment were found to be 2 times more common in children who failed treatment compared with children who were treated successfully. In addition, the parents of children who failed treatment had a negative view of their child, which was reflected in the difficulty of parents to abandon the belief that their child was having fecal incontinence intentionally [40]. Significantly higher rates of oppositional behavior were reported by parents of children with a frequency of fecal incontinence episodes of >1 per week, compared with parents of children with a frequency of incontinence episodes <1 per week. Another study, that compared 86 children with fecal incontinence to 62 non-symptomatic children, showed that incontinent children have more disruptive behavior according to their parents and teachers [41]. Children with fecal incontinence are not viewed by their parents as noncompliant in general, but are considered to be specifically noncompliant to toileting instructions. Children with frequent episodes of fecal incontinence also exhibited more antisocial activities and bullying compared with children who had fecal incontinence occasionally [42].

It has been shown that most of the behavioral issues associated with constipation are relieved after successful treatment [1,40]. Therefore it is possible that the social impact of the incontinence is responsible for some of the abnormal behavior that can be seen [15,40,43].

Urinary incontinence associated with constipation

In children with functional fecal incontinence, it has been reported that daytime urinary incontinence can occur in up to 24%, and nighttime incontinence in 31% [23]. It has also been reported that approximately one third of children who had constipation and attended a tertiary care clinic had nighttime urinary incontinence [44,45]. Furthermore, it has been shown that in many instances, successful treatment of constipation leads to the resolution of the urinary incontinence [17,45,46].

Why urinary incontinence is related to bowel movement problems is not clear [46]. On the one hand, bedwetting and stool retention both have been associated with maturational disorders of the central nervous system, resulting in children having difficulty with attending to or reacting on internal physical cues [39]. On the other hand, it has been suggested that

bladder obstruction by a distended rectum full of stool may be responsible by exerting direct pressure on the bladder wall, leading to detrusor hyperactivity [46,47]. Other postulated possible factors include a shared nerve innervation, abnormal pelvic floor function, or behavioral causes [47,48]. In a recent study in which combined urodynamics and rectal barostat were used in children with constipation and urinary tract symptoms, it was found that in 70%, rectal distention significantly, but unpredictably affected bladder capacity, sensation and overactivity [47]. It was also suggested that a temporary fecal mass rather than chronic constipation affects the bladder [47], an observation that is consistent with clinical observation in which urinary dysfunction improves in children with constipation after there is evacuation of the rectal stool mass [17]

Differential diagnosis of fecal incontinence in children

Even though the majority of otherwise normal children with fecal incontinence have underlying constipation, 10–20% have functional non-retentive fecal incontinence (FNRFI) [7]. These children need to be identified, as the treatment is very different and their problem can be exacerbated by the use of laxatives [16]. The definition for FNRFI proposed by the Rome III Committee is in a child with a developmental age of at least 4 years, with a history of defecation in places inappropriate to the social context at least once per month, with no evidence of an inflammatory, anatomic, metabolic, or neoplastic process, and no evidence of fecal retention for at least 2 months before diagnosis [4,7,49]. The exact prevalence is not known, as in most studies FNRFI is lumped together with incontinence related to constipation. It has been suggested that in children with functional fecal incontinence, 80% have fecal retention, and 20% have FNRFI [7]. In a recent study, it was reported that FNRFI occurred in 9% of children referred to a tertiary care facility for constipation [50]. FNRFI is more common in boys; male to female ratios range from 3:1 to 6:1 [7,16]. Patients with FNRFI have otherwise normal bowel habits, with a normal defecation frequency and normal stool consistency [7]. Normal colonic transit time in combination with a normal defecation pattern without a fecal mass on physical examination confirms the diagnosis of FNRFI [49]. The pathophysiology of the fecal incontinence in FNRFI is not well understood. It has been associated with emotional disturbance, and it has been suggested that children with FNRFI deny or neglect their normal physiological stimuli to defecate in the toilet and contract the external anal sphincter to retain stool in the rectum [7,16]. The frequency of daytime and nighttime urinary incontinence is also higher compared with constipated children, suggesting an overall delay in the achievement of toilet training, or the neglect for normal physiological stimuli to go to the toilet. An appropriate diagnosis of FNRFI is important, as if the patient is diagnosed as having underlying constipation and laxatives are administered, the incontinence gets exacerbated [7].

Organic causes of fecal incontinence need to be excluded [10]. In most cases the presence of congenital malformations will be evident (like anorectal malformations, or myelomeningocele), but there are organic conditions that may not be so evident and need to be considered in the evaluation of children with fecal incontinence. These include tethered cord, other neurologic conditions, malabsorption syndromes, or endocrine disorders [6,10]. A careful physical examination and some basic blood work may be necessary to exclude these conditions [6,10]. Occasionally a spinal MRI will be needed if the presence of a tethered cord is suspected [51]

Response to treatment in children with functional fecal incontinence

The treatment of constipation is beyond the scope of this chapter. The important point however is that in general fecal incontinence responds to laxative therapy, something that has been shown in multiple randomized trials. What, if any, is the extra effect on fecal incontinence of using behavior modification and other techniques is not clear. In a

comparative study of 3 different interventions (medical therapy, medical therapy plus enhanced toilet training and medical therapy plus enhanced toilet training plus biofeedback), Borowitz *et al.* found no difference in treatment success of the constipation, but the enhanced toilet training intervention was considered more effective because those children had less fecal incontinence [36]. In other studies in which behavioral therapy has been added to traditional medical therapy, it has been shown that the behavioral therapy relieves behavioral problems, but showed no advantage on the treatment of the constipation or of the fecal incontinence [1].

Children with constipation and fecal soiling are more difficult to treat [21]. In randomized studies of the treatment of childhood constipation, it has also been shown that within those children with incontinence, patients with a lower frequency of incontinence episodes tend to respond better to treatment [21]. Furthermore, in a long term study that followed 418 children to establish the natural history of constipation, it was found that a higher frequency of fecal incontinence episodes at presentation was associated negatively with a good clinical outcome. In this study, a difference of 7 incontinence episodes in frequency at intake lowered the probability of having a good outcome by 15% (relative risk: 0.87; 95% confidence interval, 0.80–0.94) [27].

Even though the administration of laxatives is the mainstay of therapy for children with constipation, and that successful treatment controls the fecal incontinence, it has been reported that at times, fecal incontinence can be exacerbated by the use of laxatives. In fact studies of PEG3350 have shown that fecal incontinence is a common side effect [22,52,53]. This effect may be related to the dose of laxatives that is being used, as has been shown in two recent dose escalating protocols of PEG based laxatives [22,54]. This needs to be taken into account when children with constipation are being treated, as there is always the tendency to administer more laxatives when fecal incontinence is not responding to therapy.

COEXISTENT CONSTIPATION AND FECAL INCONTINENCE IN ADULTS

Epidemiology

As in the pediatric field, the association between fecal incontinence (FI) and constipation has long been recognised in geriatric medicine [55], with fecal impaction accepted as being the most common cause of involuntary stool loss in the elderly, typically as ‘overflow’ [55–60]. However, although a considerable body of literature exists regarding impaction-related incontinence at opposite ends of the age spectrum, there is a striking paucity of information in non-geriatric adults; indeed, in a number of recent authoritative reviews, the concept that constipation / rectal evacuatory dysfunction may be a pathoetiological factor in the development of FI is simply overlooked, or, at best, given limited acknowledgement [60–64]. Although pelvic floor weakness and denervation, perhaps through chronic straining at stool, was historically regarded as the primary pathological mechanism underlying acquired FI [65–67], the advent of endoanal ultrasonography in the early 1990’s, and seminal studies of obstetric-related injury [68], shifted focus to anal sphincter disruption as the most important causative factor [60,61]. However, given that the prevalence of FI in the adult population is equivalent between genders [69–71], the importance of obstetric-related injury has likely been overemphasised. Furthermore, most women report the onset of their symptoms of FI many years after childbirth [72,73], indicating that other contributory factors are involved. It is only in the past 5 or so years that the link between underlying constipation and FI has again begun to gain a firm appreciation [74].

In the general adult population, the coexistence of constipation and fecal incontinence is unknown, though given their overall prevalences (~15% and 4 – 9%, respectively) [69–71,75,76], overlap is likely considerable. Indeed, recent postal questionnaire-based studies in

the general community have revealed constipation as an independent risk factor for the presence of FI [77–81]. Kalantar *et al.* showed that a feeling of incomplete evacuation was significantly associated ($P<0.0001$) with FI, with an odds ratio (OR), determined from 49 incontinent subjects versus 428 continent controls, calculated as 3.7 [95% CI, 2 – 7] [77]. Similarly, Damon *et al.*, in a postal survey of 706 subjects, found that 63% of incontinent respondents reported difficulties with defecation, and 51% felt that they never completely emptied their rectums; these frequencies were significantly higher than in continent controls ($P=0.006$ and $P<0.0001$, respectively) [78]. More recently, Bharucha *et al.* also showed that a sense of incomplete evacuation was a risk factor for FI in 154 incontinent women versus 127 continent controls (OR 3.5, 1.4–8.8) [79]. This work has been extended to show that 26% of randomly selected women with FI (46/176) had a history of chronic constipation, with presence of rectocele (from medical documentation) being a strong independent risk factor (OR 4.9, 1.3 – 19) [80]. In an Arabic community sample of 596 women, 62 of whom were found to have FI, constipation was also found significantly more frequently ($P<0.0001$) than in the continent control group [81].

The story is similar in patients attending specialist clinics. Boreham *et al.* found FI to be present in 28% of 457 women presenting for gynecological care, and using logistic regression modeling, showed constipation to be a risk factor (OR 2.1, 1.2 – 3.6) [82]. Damon *et al.* studied the results of a questionnaire survey in 835 patients presenting at gynecology and gastroenterology clinics, and found that 29% of patients with FI had a regular or persistent problem with defecation compared to only 10% of non-incontinent patients. In addition, 29% of the incontinent cohort regularly digitated, and 20% used regular laxatives, versus only 9% and 10% of continent patients, respectively [78]. Finally, Amselem *et al.* looked at 596 women attending a gynecology clinic, and defined pelvic floor damage based on the presence of 2 or more of 5 criteria, including urinary and fecal incontinence [83]. Constipation was based on 7 criteria, present 25% of the time or more (straining, sensation of anal blockage during defecation, digitation, sensation of incomplete evacuation, passage of hard stools, less than three bowel movements per week, and regular use of laxatives, enemas or suppositories), and 18% of patients fulfilled at least 3 of these criteria. Univariate analysis, after age adjustment, showed constipation to be a risk factor for pelvic floor damage (OR 2.4, 1.3–4.5; $P < 0.0044$) [83].

In specialist colorectal referral centers, information is limited. In a small sample of 38 patients with descending perineum syndrome, 97% had symptoms of constipation, including a sense of incomplete evacuation in 92% and need for excessive straining in 97%. Of these, 15% were reported as having FI [84]. In patients referred for proctographic examination, retention of contrast in large rectoceles or demonstration of incomplete evacuation has been shown to have excellent correlation with the presence of clinical symptoms of outlet obstruction constipation present concurrently with incontinence [85]. Agachan *et al.* reported that 16% of 154 consecutive patients with a primary diagnosis of FI, who were undergoing proctography, had a diagnosis of coexistent constipation [86]. Results from our own centre were initially equivalent. In 2003, we published that intractable constipation and FI were present in 229/1351 patients (17%) referred consecutively for investigation of their symptoms of hindgut dysfunction [87]. However, these findings were derived from face-to-face clinical history taking, and were compiled prior to the standard use of a comprehensive clinical questionnaire now mailed routinely to patients before their appointment. It is well recognized that patients are reluctant to volunteer symptoms of FI, and that practitioners may not enquire of them [88,89]. More recently, in a consecutive series of 200 patients presenting primarily with symptoms of a rectal evacuatory disorder, 91 (46%) of subjects self-reported FI using the questionnaire; this was confirmed on interview [90]. This work has been extended to incorporate allcomers presenting to our specialist tertiary referral centre for investigation of either constipation or incontinence [91]. In a consecutive series of

262 patients, 169 presented primarily with constipation, of whom 60 (36%) reported co-existent FI. Conversely, 93 patients presented primarily with FI, of whom 32 (34%) reported significant symptoms of constipation. Severity of incontinence was similar between those patients with FI alone (median St. Mark's incontinence score 12 [3–24]), and patients with co-existent constipation and FI (median 10 [1–22]). Of particular note, the coexistence of both complaints was acknowledged in the referring clinician's letter in only 20 / 92 cases (22%) [91]. We have also looked specifically at 161 consecutive male patients with FI, and shown that 48% reported concurrent constipation [92]. Whether these results can be extrapolated to the general population is unknown.

The coexistence of constipation and incontinence is recognized as being much higher in association with specific clinical pathologies, including spinal cord injury [93], and congenital anorectal anomaly [94]. However, a detailed description of these conditions is beyond the scope of this review.

Pathophysiology of incontinence associated with constipation in adults

The unifying concept is that in patients with coexistent constipation and FI, the incontinence occurs as a secondary phenomenon. Pathophysiology is multifactorial; however, three principal mechanisms are now recognised, of which there may be overlap: (i) 'overflow' due to fecal impaction, particularly in the elderly; (ii) involuntary, usually post-defecation leakage, due to retention of stool in the rectum as a consequence of a rectal evacuatory disorder; (iii) a generalised pelvic floor weakness / denervation.

Overflow incontinence secondary to fecal impaction—Prevalence of incontinence increases with advancing age, and in the geriatric population, particularly institutionalised individuals, rates of FI may approach 50% [95]; prolonged retention of stool in the rectum, perhaps secondary to incomplete evacuation during defecation, but also as a consequence of other factors [59], such as physical immobility, inadequate diet and water intake, depression, associated neurological (e.g. dementia) and metabolic disorders (e.g. hypothyroidism), and use of constipating drugs (e.g. narcotics, antipsychotics and antidepressants), which may retard colonic propulsion, can lead to fecal impaction [56–59]. This may result in overflow incontinence, which can be exacerbated by laxative use [96], which causes liquid stool to seep around the fecal bolus [97]. The presence of an impacted mass will also stimulate the secretion of large volumes of mucus, which will further aggravate the problem [97]. Such overflow leakage has been attributed to a combination of an obtuse anorectal angle, secondary to pelvic floor denervation (see below), reduced anal resting tone, possibly secondary to persistent reflex inhibition, and decreased anal and rectal sensation, which prevents conscious contraction of the external anal sphincter; this allows liquid stool to escape through the anal canal [57,74,97,98].

In non-geriatric constipated adults, fecal impaction may also occur due to a combination of impaired rectal sensitivity (hyposensitivity), increased rectal compliance (rectal wall laxity: hypercompliance), and increased rectal dimensions (anatomical megarectum); these factors contribute to fecal retention by decreasing the frequency and intensity of the desire (and hence the motivation) to defecate [99]. In megarectum, Verduron *et al.* reported that fecal incontinence was present in 57% (20/35) of patients who had acquired their condition, and 100% (7/7) with congenital megarectum [100]. There is a growing body of literature concerning the importance of rectal hyposensitivity to the development of functional anorectal disorders. Intact anorectal sensation is fundamental to normal defecation and continence. In an audit of 1351 consecutive patients referred for investigation of symptoms of hindgut dysfunction, the highest incidence of rectal hyposensitivity (27%) was found in patients with coexistent constipation and incontinence [87]. Of these patients, the nature of

the incontinence in the majority (85%) was passive, and often following defecation, suggesting that this represented overflow, or was secondary to incomplete evacuation [101]. The precise pathophysiological mechanisms underlying such fecal leakage may be equivalent to those in the geriatric population. Furthermore, impairment of perception of rectal distension may contribute to FI by causing the threshold for reflex inhibition of the recto-anal inhibitory reflex (which in health allows for 'sampling' of rectal contents in the upper anal canal) [102] to occur before the patient perceives stool in the rectum [99,103–106]. In the absence of a compensatory external anal sphincter contraction (an event requiring conscious perception) [107], stool will enter the anal canal with the potential for passive leakage [103].

Additionally, a minority of patients with rectal hyposensitivity and constipation will seemingly paradoxically complain of extreme urge fecal incontinence. This is presumably due to impairment of rectal sensation leading to a markedly attenuated, or 'late recognition' of perhaps a considerable volume of stool in the rectum, and a reduced 'warning' of the sense of impending defecation, which may ultimately be conveyed when feces impinge upon the upper anal canal [99].

Incontinence secondary to a rectal evacuatory disorder—Fecal seepage, clinically distinct from more major passive or urge-related FI, presents as the unintentional loss of small amounts of stool, usually in the hours following defecation, which is of sufficient volume to stain patients' underwear. In addition, patients may describe difficulties in wiping themselves clean after opening their bowels, and of associated pruritis ani [106,108]. Recent evidence suggests that such seepage occurs most frequently in patients with incomplete rectal evacuation, secondary to a dyssynergic pattern of defecation [108]. In 25 patients with fecal seepage, manometric investigation revealed that maximum rectal pressure was lower ($P<0.01$) and residual anal pressure was higher ($P<0.01$) during straining in comparison to 43 healthy controls. In addition, 29% of patients were unable to expel a rectal balloon [108]. Notably, rectal sensation was found to be impaired in patients with dyssynergic defecation, which supports the observations of others [99,106], and reinforces the concept that intact rectal sensation is required for adequate recto-anal coordination and appropriate relaxation of the pelvic floor during defecation. Rectal hyposensitivity (see above) is most commonly associated with evacuatory disorders characterised by a 'functional' outlet obstruction, although the cause-effect relationship remains unclear [87].

Mechanical obstructive phenomena (e.g. rectocoele and intussusception) may also cause incomplete rectal emptying, resulting in allied incontinence. It has been shown that in some patients with symptoms of both FI and rectal evacuatory dysfunction (in whom tests of sphincter function cannot account for the incontinence), symptomatic improvement can be derived from surgical correction of the observed recto-anal intussusception and / or rectocoele [109–111]. Slawik *et al.* showed that 54% of 86 patients with recto-genital prolapse were incontinent prior to laparoscopic ventral rectopexy. Incontinence improved post-operatively in 91%, with symptoms of obstructed defecation being resolved in 20/25 patients (80%) who complained of this pre-operatively [110].

Incontinence due to pelvic floor weakness—As mentioned above, prior to the widespread use of endoanal ultrasonography, the primary pathological mechanism of acquired FI was considered to be pelvic floor weakness and denervation. Studies performed 30 years ago consistently reported that a significant proportion of patients with FI gave a history of chronic straining at stool, secondary to constipation, and often presented with marked perineal descent (i.e. the perineum descends below the plane of the ischial tuberosities) [65–67,84,112]. With regard to anal sphincter function, excessive straining may result in a traction-induced pudendal neuropathy, resulting in a more obtuse anorectal angle

and lower anal sphincter pressures, predisposing the subject to incontinence. Electrophysiological studies have confirmed that the nerve supply to the puborectalis and external anal sphincter muscles can be damaged in patients with chronic constipation, likely secondary to perineal descent [65,66]. The impact of chronicity of the disorder is supported by a longitudinal study performed in patients with descending perineum syndrome, which showed that 13 of 24 [108] subjects had become incontinent when investigated for a second time, at least 5 years after their initial assessment [113].

A more generalised pelvic floor weakness may also account for ineffective evacuation in association with rectocele, descending perineum syndrome, or overt or internal rectal prolapse, and may be ascribed to a dissipation of the force vectors generated during straining [114,115]. Of course, evacuatory disorders are just one of a spectrum of pelvic floor disorders, which also include pelvic organ prolapse and urinary and fecal incontinence, and which are extremely prevalent, and rarely occur in isolation [116]. Although the etiology of these conditions remains unclear, Petros and Swash have recently proposed a unifying hypothesis, centred on weakness of the musculo-elastic supporting structures to the pelvic floor [117]; causes including ageing, pregnancy and delivery, connective tissue disorders [90] or secondarily from years of straining to evacuate.

Evaluation

Given the frequent coexistence of constipation and fecal incontinence, comprehension of the process of defecation should be considered fundamental to the clinical management of patients with FI, utilising techniques such as balloon expulsion or barium or magnetic resonance proctography [74,79,91].

CONCLUSIONS

In children, functional fecal incontinence is a common problem that is usually associated with the presence of constipation and stool retention [4]. The pathophysiology is still not well understood [29], but successful treatment of the constipation usually results in disappearance of the fecal incontinence [4,22]. Even though many children with fecal incontinence have behavioral problems, these are thought to be secondary to the incontinence, and will improve once the problem is corrected [39].

In contrast to pediatric and geriatric populations, the coexistence of constipation and fecal incontinence is a grossly underappreciated problem in adult patients. Recent work suggests that around one-third of adult individuals presenting at tertiary care level suffer from incontinence [91]. Incontinence secondary to constipation challenges (and provides a plausible explanation for) the central epidemiological dogma of acquired FI, that obstetric-related anal sphincter injury is the primary pathological mechanism; however, it is now clear that incontinence rates are equivalent between genders. Furthermore, the seemingly paradoxical clinical response in patients with either FI [118] or constipation [119] to sacral nerve stimulation (i.e. both groups benefit) may reflect the fact that they reside in common pathoetiologies [90]. Currently, both for clinical and research purposes, these conditions are usually treated independently [115]; this situation needs to be reversed if we are to improve management.

PRACTICE POINTS

- Functional fecal incontinence occurs throughout life, although it is grossly under-appreciated in the adult population;
- In both children and adults, it is frequently the result of overflow incontinence, but in adults it may also be the result of pelvic floor dysfunction;

- In children, an organic pathology is rarely found, and thus major testing in the routine evaluation of these patients is not required. In adults, physiological testing, in those refractory to conservative therapies and in whom quality of life is impacted, should address both continence and defecation mechanisms.

RESEARCH AGENDA

- Understand better the epidemiology of coexistent constipation and fecal incontinence in adults;
- Understand better the pathophysiology of fecal incontinence associated with constipation both in children and adults.

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