Relationship between symptoms and disordered continence mechanisms in women with idiopathic faecal incontinence

A E Bharucha, J G Fletcher, C M Harper, D Hough, J R Daube, C Stevens, B Seide, S J Riederer, A R Zinsmeister

Background and aims: Anal sphincter weakness and rectal sensory disturbances contribute to faecal incontinence (FI). Our aims were to investigate the relationship between symptoms, risk factors, and disordered anorectal and pelvic floor functions in FI.

Methods: In 52 women with “idiopathic” FI and 21 age matched asymptomatic women, we assessed symptoms by standardised questionnaire, anal pressures by manometry, anal sphincter appearance by endoanal ultrasound and magnetic resonance imaging (MRI), pelvic floor motion by dynamic MRI, and rectal compliance and sensation by a barostat.

Results: The prevalence of anal sphincter injury (by imaging), reduced anal resting pressure (35% of FI), and reduced squeeze pressures (73% of FI) was higher in FI compared with controls. Puborectalis atrophy (by MRI) was associated (p = 0.05) with FI and with impaired anorectal motion during pelvic floor contraction. Volume and pressure thresholds for the desire to defecate were lower, indicating rectal hypersensitivity, in FI. The rectal volume at maximum tolerated pressure (that is, rectal capacity) was reduced in 25% of FI; this volume was associated with the symptom of urge FI (p < 0.01) and rectal hypersensitivity (p = 0.02). A combination of predictors (age, body mass index, symptoms, obstetric history, and anal sphincter appearance) explained a substantial proportion of the interindividual variation in anal squeeze pressure (45%) and rectal capacity (35%).

Conclusions: Idiopathic FI in women is a multifactorial disorder resulting from one or more of the following: a disordered pelvic barrier (anal sphincters and puborectalis), or rectal capacity or sensation.

METHODS

Participants

Between June 2000 and February 2003, 52 consecutive female patients (mean age 63.4 (SEM 3.9) years) with FI and 21 healthy asymptomatic women (aged 61.5 (2.4) years) were recruited.

Abbreviations: Fl, faecal incontinence; MRI, magnetic resonance imaging; EMG, electromyography; DD, desire to defecate; ROC, receiver operating characteristic; BMI, body mass index

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consented to participate in this study, which was approved by the Institutional Review Board of the Mayo Clinic. A clinical interview and physical examination were performed in all participants. Healthy controls were recruited by public advertisement. Exclusion criteria for controls included significant cardiovascular, respiratory, neurological, psychiatric, or endocrine disease, irritable bowel syndrome as assessed by a validated bowel disease questionnaire, and medications (with the exception of oral contraceptives or thyroid supplementation), and abdominal surgery (other than appendectomy or cholecystectomy). In addition, healthy subjects who had any previous anorectal operations, including haemorrhoid procedures, or had sustained anorectal trauma during delivery (that is, grade 3 or 4 laceration), as documented by obstetric records, were excluded. Patients with a neurological disorder (for example, diabetes mellitus with neuropathy) or connective tissue disease (for example, scleroderma), or previous major anorectal surgery (for example, for rectal prolapse or anal sphincter defects) known to be associated with FI were excluded. The principal investigator also assessed six other patients who were eligible but declined to participate in the study.

Design

In addition to a clinical assessment, anal pressures, rectal compliance, rectal sensation, anal sphincter structure (by endoanal ultrasound and magnetic resonance imaging (MRI)) and pelvic floor motion (by MRI) were assessed in all healthy subjects and incontinent patients. The pelvic floor muscles were also evaluated by concentric needle electromyography (EMG) in incontinent patients. All assessments were completed over a 72 hour period.

Clinical assessment

In addition to evaluation by a gastroenterologist, all patients completed a validated questionnaire pertaining to bowel symptoms, abdominal discomfort, as well as severity and circumstances surrounding FI. The severity of FI was graded by a validated scale incorporating the type and frequency of incontinence, presence and severity of urgency, and use of sanitary devices for incontinence (table 1). FI was characterised as urge, passive, combined (that is, urge and passive), or neither, based on patient responses to the questionnaire. Those patients who reported they were “often” or “usually” incontinent because they had “great urgency and could not reach the toilet on time” were considered to have urge incontinence. Those patients who reported they were “often” or “usually” “unaware when the leakage was actually happening” were considered to have “passive” incontinence.

Anorectal manometry

Procedure

Anal sphincter pressures were measured by a pneumatic manometric perfusion system incorporating four water perfused transducers evenly distributed around the catheter circumference at the same level along the longitudinal axis. A station pull through technique was employed, recording resting and squeeze pressures three times at 1 cm intervals in the anal canal. Subjects were encouraged to maintain squeeze for 30 seconds; a rest period of 45 seconds separated sequential squeeze measurements.

Data analysis

By convention, the average resting pressure over 30 seconds and the maximum squeeze pressure during 30 seconds were analysed. At every level, pressures were averaged across all four transducers. Average resting and squeeze pressures were the highest circumferential pressures recorded at rest and during squeeze, respectively, at any level in the anal canal, averaged across three manoeuvres. We have recently demonstrated that anal pressures measured by these methods are reproducible.14

Rectal compliance and sensation

Procedure

After two magnesium citrate enemas (Fleets; CB Fleet, Lynchburg, Virginia, USA), rectal compliance and sensation were recorded by an “infinitely” compliant 7 cm long balloon with a maximum volume of 500 ml (Hefty Baggies; Mobil Chemical Co., Pittsford, New York, USA) linked to an electronic rigid piston barostat (Mayo Clinic, Rochester, Minnesota, USA) as previously described.15,16 An initial or conditioning distension was performed to reduce variability in rectal sensory thresholds and compliance thereafter.20 Then, a rectal staircase distension (0–32 mm Hg in 4 mm Hg steps at one minute intervals) was conducted. Rectal compliance and sensory thresholds for first sensation, desire to defecate (DD), and urgency were recorded during the staircase distension; the threshold was the first sensation of each symptom.

Data analysis

As previously described, rectal pressure-volume relationships were analysed by averaging balloon volume over the second 30 second segment at each pressure.19,21 Thereafter, each compliance curve was summarised using a power exponential model as previously described using the NLIN procedure in the SAS software package.19,22 Estimated k and β for each subject were used to calculate the pressure corresponding to half maximum volume (P half), a measure of rectal compliance. Maximum volume during the compliance curve reflected rectal capacity.

Data for sensory thresholds that were not recorded were imputed using a “censored” data approach. When the first sensation threshold was not perceived, this threshold pressure was imputed using the perceived threshold for DD or urgency, whichever came earlier. The threshold for DD was imputed using the urgency threshold or the highest pressure during the pressure-volume curve, whichever came first. As 68/73 subjects experienced DD during rectal distension, this threshold was used in subsequent analyses.

<table>
<thead>
<tr>
<th>Grade 1</th>
<th>Grade 2</th>
<th>Grade 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency of incontinence</td>
<td>Up to once/month (n = 7)</td>
<td>&lt;1/week [n = 14]</td>
</tr>
<tr>
<td>Usual type of bowel incontinence</td>
<td>Gas only/enough to stain underwear (size of a quarter) (n = 11)</td>
<td>Small amount of stool (n = 31)</td>
</tr>
<tr>
<td>No of protective pads changed/day</td>
<td>None (n = 12)</td>
<td>One (n = 22)</td>
</tr>
<tr>
<td>Urgency</td>
<td>Never (n = 9)</td>
<td>Sometimes (n = 11)</td>
</tr>
</tbody>
</table>

Maximum total score = 12. Scores of 1–4, 5–8, and 9–12 were categorised as mild, moderate, and severe faecal incontinence, respectively.
Table 2  Criteria for measuring agreement between endoanal ultrasound and magnetic resonance imaging (MRI) for the internal and external anal sphincters

<table>
<thead>
<tr>
<th>Level of agreement</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete agreement</td>
<td>Normal appearance versus mild focal thinning</td>
</tr>
<tr>
<td></td>
<td>Similar findings within two hours on the clock face</td>
</tr>
<tr>
<td></td>
<td>Similar findings located at the same or within one cranio-caudal level</td>
</tr>
<tr>
<td>Acceptable agreement</td>
<td>Marked focal thinning versus tear</td>
</tr>
<tr>
<td></td>
<td>Marked focal thinning versus scar</td>
</tr>
<tr>
<td></td>
<td>Atrophy alone versus atrophy with tear versus atrophy with scar</td>
</tr>
<tr>
<td>Disagreement</td>
<td>Similar findings separated by &gt; 1 cranio-caudal level</td>
</tr>
<tr>
<td></td>
<td>Similar findings separated by &gt; 2 hours on the clock face</td>
</tr>
<tr>
<td></td>
<td>Any other combination not listed above</td>
</tr>
</tbody>
</table>

*For external sphincter, similar findings indicates tear or scar by MRI versus defect by ultrasound.

Table 3  Clinical characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Asymptomatic subjects</th>
<th>Faecal incontinence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>61.5 (2.4)</td>
<td>61.2 (2)</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>26.5 (0.9)</td>
<td>28.6 (0.9)</td>
</tr>
<tr>
<td>No of vaginal deliveries</td>
<td>1.8 (0.3)</td>
<td>2.9 (0.3)</td>
</tr>
<tr>
<td>Subjects with any forceps deliveries</td>
<td>5 (24%)</td>
<td>26 (50%)</td>
</tr>
<tr>
<td>No of deliveries requiring perineal stitches</td>
<td>None</td>
<td>11 (52%)</td>
</tr>
<tr>
<td></td>
<td>1–3</td>
<td>10 (48%)</td>
</tr>
<tr>
<td></td>
<td>&gt;3</td>
<td>5 (10%)</td>
</tr>
<tr>
<td>Hysterectomy</td>
<td>7 (33%)</td>
<td>30 (58%)</td>
</tr>
</tbody>
</table>

Values are mean (SEM).

*Unknown = 2.
Nicolet Biomedical Inc, Madison, Wisconsin, USA) in 51, 44, and 40 patients, respectively, by standard techniques, and normal values developed in the Mayo EMG laboratory.

Data analysis

Insertional activity at rest and motor unit potential amplitude, duration, percent polyphasia, and recruitment following mild to moderate voluntary muscle contraction were assessed in a standardised semiquantitative manner that has been demonstrated to have minimal intraobserver and interobserver variability.

Statistical analysis

All measured parameters were considered normal or abnormal based on the 5th–95th percentile range for controls. Associations were assessed by $\chi^2$ or Fisher’s exact test. The associations we evaluated were between subject status (that is, control or FI) versus baseline clinical characteristics (for example, obstetric history, bowel habits) and anal sphincter appearance by ultrasound/MRI. In addition, the associations between symptom subtype with rectal compliance and sensation, and between anal sphincter appearance and function were assessed. A proportional hazards regression model assessed the association between sensation threshold for DD and rectal compliance, capacity, and group status. In this model, sensory thresholds were censored as described above for five of 73 subjects (that is, two patients and three controls) who did not perceive DD during rectal distension.

Receiver operating characteristic (ROC) curves evaluated the sensitivity and specificity of anorectal assessments for discriminating between health and FI. A logistic regression model analysed whether demographic variables (that is, age, body mass index (BMI), obstetric-gynaecological history [that is, number of forceps deliveries, episiotomies, and hysterectomy status], anal pressures (categorised as normal or reduced), anal sphincter appearance and pelvic floor motion by MRI, and rectal compliance could discriminate between controls and FI.

A multiple linear regression model analysed the extent to which variation in objective anorectal function parameters could be explained by predictor variables, including obstetric history and anal sphincter appearance by MRI. Obstetric history and anal sphincter appearance (by MRI) were each collapsed into two categories. Thus for obstetric history, the analysis evaluated the predictive utility of “mild” (that is, subjects with four or more vaginal deliveries but no known episiotomy or forceps delivery) and “severe” injury (that is, subjects with a previous episiotomy or forceps delivery) relative to a reference group without known risk factors (that is, <4 vaginal deliveries with no episiotomy or forceps delivery). For anal sphincter injury, the analysis evaluated the predictive utility of internal and/or external sphincter tears only, and sphincter atrophy with or without tears, relative to normal appearing anal sphincters.

RESULTS

Clinical characteristics

Following a questionnaire based evaluation of symptoms, 19 (37%) patients had urge, eight (15%) passive, and 13 (25%) combined incontinence. Twelve (23%) patients had neither urge nor passive incontinence. Based on the scoring system (table 1), one (2%) patient had mild (that is, score 1–4), 23 (44%) moderate (score 5–8), and 28 (54%) severe (score 9–12) FI. Thirty three patients (67%) had functional bowel disorders; 13 had diarrhoea predominant irritable bowel syndrome, eight had functional constipation, seven had functional diarrhoea only, and five patients had diarrhoea predominant irritable bowel syndrome and functional constipation. Demographic features are detailed in table 3. Forceps assisted deliveries (p<0.05), deliveries associated
with perineal stitches ($p<0.05$), and hysterectomy status ($p<0.05$) were all separately associated with FI. In addition to forceps deliveries, eight (15%) additional patients had other risk factors for anal sphincter injury—that is, definite obstetric trauma or anorectal surgical procedures.

**Disordered anal sphincter structure and function**

FI was associated ($p<0.01$) with an abnormal appearance (that is, marked focal thinning, scars, defects, or atrophy) of the internal and/or external sphincters by MRI (table 4; see figs 2–3). No control and three patients had atrophy of the internal sphincter. One of 21 (5%) controls and 13 of 51 (25%) patients ($p = 0.05 \, v \, \text{controls}$) had atrophy of the external sphincter.

Agreement between endoanal ultrasound and MRI for the appearance of the internal sphincter was complete or acceptable (as defined in table 2) in 95% of controls and 81% of incontinent patients. For the external sphincter, agreement was complete or acceptable in 95% of controls and 77% of incontinent patients. For the internal sphincter, tears identified by ultrasound, but not by MRI, constituted the primary source for disagreement, accounting for 46% of the discrepancies between these two tests. For the external sphincter, atrophy was visualised by endoanal MRI only.
accounting for 59% of the disagreements between ultrasound and MRI (fig 1). Average anal resting and squeeze pressures in controls were mean 53 (SEM 5) and 128 (8) mm Hg, respectively. Average resting pressure was reduced in 18 (35%) patients and average squeeze pressure was reduced in 38 (73%) patients with FI (fig 2); both resting and squeeze pressures were normal in only nine (17%) patients. External sphincter tears or atrophy were associated (p = 0.02) with lower average squeeze pressures (that is, less than the 5th percentile value for controls).

**Puborectalis structure and function**

The puborectalis muscle appeared normal in 20/21 (95%) controls and in 43/51 (84%) patients with FI who had an MRI. One control and five patients had asymmetric puborectalis atrophy (fig 3); three patients had bilateral (that is, symmetric) atrophy. Puborectalis atrophy was associated (p<0.05) with FI. During squeeze, the anorectal angle declined by a mean of 25˚ (SEM 2˚) in subjects without, and by 14˚ (2˚) in subjects with puborectalis atrophy. 

Fourteen of 63 (22%) subjects with a normal appearing and MRI had EMG examination of the puborectalis disclosed neurogenic, or mixed injury in 33 of 51 (65%) patients examined (table 6). EMG examination of the ischiocavernosus in 26 of these 33 patients was either normal (15 patients) or revealed changes comparable with the external sphincter (seven patients) or changes that differed from the external sphincter (four patients).

**Rectal evacuation**

Voluntary rectal evacuation was generally associated with perineal descent and a more obtuse (that is, greater) anorectal angle (table 5). In nine (18%) patients, the anorectal angle declined (instead of increasing) during evacuation, likely reflecting an evacuation disorder. Conversely, four patients had increased perineal descent during rectal evacuation.

**EMG evaluation of the pelvic floor**

EMG of the external sphincter disclosed neurogenic or mixed (that is, neurogenic and myogenic) injury in 33 of 51 (65%) patients examined (table 6). EMG examination of the ischiocavernosus in 26 of these 33 patients was either normal (15 patients) or revealed changes comparable with the external sphincter (seven patients) or changes that differed from the external sphincter (four patients).

Examination of the puborectalis disclosed neurogenic, myogenic, or mixed injury in 19 of 44 (43%) patients examined. EMG of the external sphincter disclosed the same injury pattern in 18 of these 19 patients. However, EMG disturbances of the puborectalis were not associated with puborectalis function evaluated by MRI.

**Rectal sensation**

Forty one (85%), 50 (96%), and 43 (83%) patients reported “first sensation”, DD, and urgency during rectal distension. To ascertain the prevalence of sensory disturbances in FI, we compared threshold volumes and pressures for the most frequently reported sensation (that is, DD) between controls and FI. Rectal sensory thresholds for DD, expressed as pressure (median threshold = 12 mm Hg (FI) v 16 mm Hg (controls); p<0.01) or volume (median threshold = 87 ml (FI) v 162 ml (controls); p<0.001) were lower in FI, indicating hypersensitivity. The pressure threshold for DD was lower (p<0.01) in FI relative to controls, even after adjusting for rectal compliance (that is, Pr half). Similarly, the volume threshold for
DD was lower (p = 0.02) in FI even after adjusting for differences in rectal capacity between controls and FI.

Reduced rectal capacity was associated with the symptom of urgency (p = 0.04), and with rectal hypersensitivity (that is, threshold volume for DD or urgency was lower than the 5th percentile values for controls) (p<0.01) (fig 5). On the other hand, reduced rectal sensitivity manifested by the lack of awareness of incontinence urgency during rectal distension up to 32 mm Hg was not associated with lack of awareness during an episode of FI (data not shown).

### Integrated assessment of anorectal and pelvic floor mechanisms in FI

The logistic regression model incorporating multiple variables resulted in an area under the ROC curve of 0.98 (the maximum possible area is 1) (fig 6). Age and BMI alone were not useful for discriminating between FI and controls (area under curve = 0.57). Anal pressures, pelvic MRI findings (anal sphincter morphology and pelvic floor motion), and rectal capacity, added in sequential order, enhanced the utility of the clinical variables (that is, age, BMI, obstetric history, and hysterectomy status) for discriminating between controls and FI. The perceived utility of obstetric-gynaecological variables for discriminating between controls and FI is not surprising as we excluded controls who had significant risk factors for anal sphincter injury from participating in the study. At a specificity of 90%, clinical variables and anal pressures were 82% sensitive for discriminating between controls and FI. After adding pelvic MRI findings and rectal capacity, sensitivity improved to 94%. Puborectalis dysfunction was associated (p = 0.006) with clinical severity of FI (table 7). The prevalence of other dysfunctions (for example, reduced rectal capacity) were not significantly associated with the clinical severity of FI.

### Do symptoms, risk factors, and anal sphincter morphology predict anorectal function disturbances?

The predictive variables explained 23% of intersubject variation in anal resting pressure and 46% of the variation in anal squeeze pressure (table 8). Anal sphincter injury (by MRI) was the only factor that significantly explained variation in anal resting and squeeze pressures. The symptom of urge incontinence explained a significant proportion of intersubject variation in rectal capacity and impaired pelvic floor motion from rest to squeeze.

### DISCUSSION

This study is unique as it comprehensively appraised anorectal and pelvic floor structure and functions maintaining continence, risk factors for disordered anorectal functions, and the relationship between symptoms and disordered functions in women with idiopathic FI. We demonstrated: (i) structural and functional disturbances not only in the anal sphincter but also in the puborectalis in FI; (ii) significant reduction in rectal capacity in 25% of FI patients; reduced rectal capacity was associated with rectal urgency and increased perception of rectal balloon distension; and (iii) that predictive factors (age, BMI, symptoms, obstetric history, and anal sphincter appearance) explained significant portions of the interindividual variation in anal squeeze pressures and rectal capacity in idiopathic FI. The

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**Figure 4** Rectal compliance (pressure at half maximal volume, A) and rectal capacity (maximum volume during compliance curve, B) in faecal incontinence (FI). Compared with normal values (that is, 5th–95th confidence interval) depicted by the shaded area, rectal compliance was normal, reduced (that is, high Prhalf), or increased (that is, low Prhalf) in FI. Rectal capacity, as measured by balloon volume at maximum tolerated pressure during the rectal compliance curve, was also reduced in 25% of incontinent patients.

**Figure 5** Relationship between symptoms and rectal compliance (A) and rectal compliance versus hypersensitivity (B) in faecal incontinence (FI). Reduced rectal capacity was associated with urge FI and with rectal hypersensitivity during rectal balloon distension.
One third of FI patients had reduced upward anorectal motion during squeeze, indicating puborectalis dysfunction and supporting a recent study in which puborectalis force was measured by an intrarectal dynamometer.9 Our study is the first to demonstrate puborectalis atrophy in FI and an association between atrophy and puborectalis dysfunction. The aetiology of puborectalis atrophy is unknown but all women with puborectalis atrophy had four or more vaginal deliveries and/or a forceps delivery, supporting previous studies suggesting possible muscle damage during vaginal delivery.11–14 Further studies are necessary to ascertain whether puborectalis atrophy can predict the effect of biofeedback therapy on puborectalis function. Dynamic MRI also revealed paradoxical puborectalis contraction during evacuation in nine patients. It is necessary to identify and address impaired evacuation as retention of stool to impaired evacuation may increase a tendency for incontinence.

Rectal compliance and capacity were reduced in 20% of patients with “idiopathic” FI, extending previous studies in ulcerative colitis,15 radiation proctitis,16 and idiopathic FI.17 Reduced rectal compliance was not associated with the symptom of urge FI. In the stepwise logistic regression model, reduced rectal capacity was useful for discriminating between controls and FI, underscoring the importance of reduced rectal capacity to the pathophysiology of FI. Moreover, reduced rectal capacity was associated with the symptom of urgency, and with increased rectal perception. In the linear regression model, anal sphincter atrophy predicted reduced rectal capacity. It seems unlikely that reduced capacity would cause severe anal sphincter injury or vice versa. Shared mechanisms may be responsible for both disturbances and these require further elucidation. Further studies are also necessary to ascertain if reduced rectal capacity is attributable to “active” (for example, increased rectal tone) or “passive” (for example, fibrosis) mechanisms. Rectal capacity and hypersensitivity may improve after combined rectal augmentation using a segment of distal ileum and stimulated gracilis and neosphincter.17 Lastly, the pressure threshold for the desire to defecate was lower in FI, even after correcting for differences in rectal compliance and capacity, suggesting that rectal hypersensitivity cannot be entirely explained by disturbances in biomechanical properties of the rectum.

Previous studies suggesting a relatively high prevalence of pudendal neuropathy in FI were based on delayed pudendal nerve terminal motor latencies, which are subject to methodological limitations.18 In this study, a combined assessment of external sphincter, puborectalis, and ischiocavernosus was used to localise the level of neuromuscular injury in FI. Neurogenic changes isolated to the external sphincter may be caused by injury at any level from motor neurones in the sacral spinal cord to the nerve fascicles entering the anal sphincter. Local trauma, (for example, during vaginal delivery) may damage the nerve fascicles entering the sphincter and/or result in myogenic changes affecting the external sphincter. We inferred that EMG findings suggested pudendal neuropathy only when neurogenic changes affected the anal sphincter and ischiocavernosus muscle. It is unlikely that a neurogenic injury pattern in the external sphincter and ischiocavernosus would reflect selective injury of the pudendal nerve branches that innervate these muscles.

The predictive variables evaluated in this study were reasonably useful as they explained >30% of the interindividual variation in anal squeeze pressure, rectal compliance, and capacity in FI. However, these risk factors explained <30% of the interindividual variation in anal resting pressure and rectal sensation. With the exception of rectal compliance,

Table 7 Anorectal sensorimotor dysfunctions by symptom severity

<table>
<thead>
<tr>
<th>Severity</th>
<th>Reduced anal resting pressure</th>
<th>Reduced anal squeeze pressure</th>
<th>Puborectalis dysfunction*</th>
<th>Reduced rectal capacity</th>
<th>Rectal hypersensitivity†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate (n = 23)</td>
<td>26%</td>
<td>65%</td>
<td>13%</td>
<td>22%</td>
<td>13%</td>
</tr>
<tr>
<td>Severe (n = 28)</td>
<td>39%</td>
<td>86%</td>
<td>50%</td>
<td>29%</td>
<td>21%</td>
</tr>
</tbody>
</table>

*Anorectal angle change from rest to squeeze <5th percentile value for controls.
†Perception threshold for desire to defecate <5th percentile value for controls.

The only patient with mild symptoms of FI had reduced anal resting and squeeze pressures only.
and sensation, obstetric risk factors were not particularly useful in explaining variance in anorectal functions. This may reflect methodological limitations (for example, the need to collapse obstetric risk factors into two categories (mild and severe) given sample size constraints). Alternatively, it is conceivable that while vaginal delivery is a risk factor for anal sphincter injury, its contribution to FI is exceeded by other risk factors (for example, aging), as has been reported for urinary incontinence. 22 23

We believe that our group of consecutive patients constitutes a representative sample of patients with “idiopathic” FI seen at a tertiary referral center; 65% had risk factors which were associated with weakness of the anal sphincters. 24 In addition, 67% of patients had one or more functional gastrointestinal disorders. Patients who were recruited had similar demographic and clinical features as those who declined to participate in the study (data not shown). Hence we believe that the conclusions of our study are applicable to patients in a consultative practice and future studies will need to evaluate the same questions in community FI patients.

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Conflict of interest: None declared.

REFERENCES

Table 8  Do obstetric-gynaecological risk factors, symptoms, and anal sphincter morphology predict disordered continence mechanisms?

<table>
<thead>
<tr>
<th>Predictor variable</th>
<th>Anal resting pressure</th>
<th>Anal squeeze pressure</th>
<th>Rectal capacity</th>
<th>Rectal sensation</th>
<th>Motion rest–squeeze</th>
<th>Motion rest–delegation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.04 (–)</td>
<td>0.002 (–)</td>
<td>0.014 (–)</td>
<td>&lt;0.001</td>
<td>0.022 (–)</td>
<td>0.033</td>
</tr>
<tr>
<td>BMI</td>
<td>0.001</td>
<td>0.005 (–)</td>
<td>0.001 (–)</td>
<td>&lt;0.001 (–)</td>
<td>0.020</td>
<td>0.017 (–)</td>
</tr>
<tr>
<td>Obstetric–mild*</td>
<td>0.027 (–)</td>
<td>&lt;0.001 (–)</td>
<td>0.038</td>
<td>0.061*</td>
<td>0.018</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Obstetric–severe*</td>
<td>0.015 (–)</td>
<td>0.007</td>
<td>0.001 (–)</td>
<td>0.025</td>
<td>0.007</td>
<td>0.009</td>
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<tr>
<td>Hysterectomy</td>
<td>0.030 (–)</td>
<td>0.001 (–)</td>
<td>0.011</td>
<td>0.045 (–)</td>
<td>0.001</td>
<td>0.002 (–)</td>
</tr>
<tr>
<td>Urge incontinence</td>
<td>&lt;0.001</td>
<td>0.052 (–)</td>
<td>0.061*</td>
<td>0.026</td>
<td>0.112*</td>
<td>0.013</td>
</tr>
<tr>
<td>Passive incontinence</td>
<td>0.001 (–)</td>
<td>0.002 (–)</td>
<td>0.008 (–)</td>
<td>0.021</td>
<td>0.069*</td>
<td>0.062*</td>
</tr>
<tr>
<td>Internal and/or external sphincter tear only</td>
<td>0.047 (–)</td>
<td>0.007</td>
<td>0.011</td>
<td>0.001</td>
<td>0.001</td>
<td>0.005</td>
</tr>
<tr>
<td>Internal and/or external sphincter atrophy-tear</td>
<td>0.063 (–)</td>
<td>0.263 (–)</td>
<td>0.099*</td>
<td>0.014</td>
<td>0.047 (–)</td>
<td>0.019</td>
</tr>
<tr>
<td>Total variance</td>
<td>0.23</td>
<td>0.45</td>
<td>0.35</td>
<td>0.23</td>
<td>0.18</td>
<td>0.25</td>
</tr>
</tbody>
</table>

All values except last row are squared partial correlation coefficients. (–), an inverse correlation between risk factor and objective parameter. BMI, body mass index. *Obstetric: the “mild” category includes subjects with four or more vaginal deliveries but no known episiotomy or forceps delivery. The “severe” category includes subjects with a previous episiotomy or forceps delivery. Subjects who were incontinent because they “often” or “usually” had great urge and could not reach the toilet on time were defined as having “urge” incontinence. Subjects who were not aware of leakage of stool during an incontinence episode were defined as having “passive” incontinence. 

*p<0.05; tp<0.01; tp<0.005.
Gut Tutorial: cholangiocarcinoma

Educational objectives

The case is designed to revise the basic diagnosis and management strategies for biliary obstruction, with a particular view to underlying biliary malignancy. After working through this tutorial you should be familiar with the history and management of biliary tract malignancy, including:

- epidemiology
- risk factors
- anatomical classification
- clinical features
- diagnosis from blood tests as well as imaging
- treatment options (surgical, endoscopic, chemotherapy, and radiotherapy)

Clinical details

An 81 year old female was admitted on acute medical take with a three week history of intermittent jaundice, vomiting, and unintentional subjective weight loss. Her clothes had become noticeably looser and she had been constipated for three days. She commented that her appetite had also become poor in this time period. There was no history of abdominal pain. She had not noticed any change in the colour of her stool or urine and had never previously had any similar symptoms. Her current medical problems included type II diabetes mellitus, biventricular heart failure, hypertension, and hyperlipidaemia. There was no history of renal or liver disease. Her usual medications included metformin, gliclazide, aspirin, frusemide, spironolactone, ramipril, amlodipine, isosorbide mononitrate, and simvastatin. There had been no recent additions to her medications.

She was a widow who lived alone but had a supportive daughter who lived next door. She was independent in all activities of daily living and prior to retirement at the age of 60 years, her occupation was as a factory assistant. There had been no recent additions to her medications.

To take part in this Gut Tutorial, go to http://cpd.bmjournals.com/cgi/hierarchy/cpd_node;89

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Relationship between symptoms and disordered continence mechanisms in women with idiopathic faecal incontinence

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