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**Bowel dysfunction after transposition of intestinal segments into the urinary tract: 8-year prospective cohort study**

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## **Abstract**

**Purpose** Bowel function may be disturbed after intestinal segments are transposed into the urinary tract to reconstruct or replace the bladder. In 1997, our group were the first to report major bowel dysfunction in a cohort of such patients: up to 42% of those who were asymptomatic preoperatively describing new bowel symptoms postoperatively including explosive diarrhoea, nocturnal diarrhoea, faecal urgency, faecal incontinence and flatus leakage <sup>1</sup>. We now describe bowel symptoms in this same cohort eight years later (2005).

**Materials and Methods** 116 patients were evaluable. Of the remaining 37 from the original report: 30 had died, five no longer wished to be involved, and two could not be traced. Patients were asked to complete postal questionnaires identical to those used in the first follow-up, assessing the severity of bowel symptoms and quality of life using two validated instruments. Responses were compared with those from the original study. The Nottingham Health Profile quality of life scores were also compared to age and sex matched norms.

**Results** 96 (83%) completed eight-year follow-up questionnaires: 43 after ileal conduit diversion (Group 1), 17 after clam enterocystoplasty for overactive bladder (Group 2), 18 after reconstructed bladder for neurogenic bladder dysfunction (Group 3), and 18 with bladder replacement for non-neurogenic causes (Group 4). High prevalence rates of bowel symptoms persisted with no statistically significant differences between the two time points. Of those with symptoms in 2005, around 50% had reported similar symptoms in 1997. Clam enterocystoplasty patients (Group 2) still reported the highest prevalence (59%) of troublesome diarrhoea with one in two on regular anti-diarrhoeal medication. They also had high rates of faecal incontinence (47%), faecal urgency (41%) and nocturnal bowel movement (18%); with high proportions reporting a moderate or severe adverse effect on work (36%), social life (50%) and sex life (43%). High rates were also reported by

neurogenic bladder dysfunction patients, including 50% with troublesome diarrhoea. This symptom was reported by 19% after ileal conduit and by 17% after bladder replacement for non-neurogenic causes. The impact of bowel symptoms on every-day activities and quality of life persisted, remaining most severe after clam enterocystoplasty, with 24% regretting undergoing the procedure because of subsequent bowel symptoms.

**Conclusions:** After more than eight years, operations involving transposition of intestinal segments continue to be associated with high rates of bowel symptoms, which impact on everyday activities. These are particularly troublesome following enterocystoplasty for overactive bladder and bladder reconstruction for neurogenic bladder dysfunction. These risks should influence patient selection and potential patients should be warned prior to surgery.

## **Introduction:**

The ideal choice of how to replace or improve the function of the lower urinary tract, when it has to be removed or when it has been rendered useless or dangerous by disease remains controversial. The current available solutions all involve using intestine. They range from: (i) urinary diversion (either conduit diversion or continent diversion), (ii) reconstruction of the bladder to (iii) replacement of the bladder with various intestinal segments. In the UK, approximately 2500 such procedures are carried out each year (<http://www.hesonline.nhs.uk>). The main indications for performing one of these procedures are bladder cancer, neurogenic bladder dysfunction, detrusor over-activity and chronic inflammatory disorders of the bladder (interstitial cystitis, tuberculosis, and schistosomiasis). Muscle invasive bladder cancer is now the commonest indication in the UK. Implications for the patient are profound irrespective of the operation chosen since most will develop significant problems after surgery that impair their quality of life<sup>2,3</sup>. Patients make significant calls on health service resources in terms of both long-term adverse effects and the requirement for stoma care and intermittent catheterisation<sup>2-4</sup>. A particularly distressing consequence of using ileal or colonic segments for this purpose is altered bowel habit, typically including loose stool, increased flatus and bowel urgency<sup>5</sup>.

A number of possible aetiological factors for bowel dysfunction have been suggested including bile acid malabsorption, reduced intestinal transit times and interruption of the ileal break mechanism<sup>5-9</sup>. To investigate the prevalence and severity of the problem we instigated a longitudinal cohort study of patients who had had transposition of intestinal segments into the urinary tract, and eight years ago we reported the results at a minimum follow up of 30 months. The main finding was that 42% of patients developed new bowel symptoms that were most common and most severe after bladder reconstruction (clam enterocystoplasty) for detrusor overactivity (54% of patients) with a high incidence of nocturnal bowel movement (18%), flatus leakage (29%), faecal urgency (39%), and faecal incontinence (32%). The

severity of bowel symptoms in this group led a third of patients to state that they regretted having the operation <sup>1</sup>.

We now report on a further assessment of this patient cohort eight years later with a minimum follow up of 10 years following surgery. The study had the following aims in respect of bowel dysfunction after reconstructive surgery:

1. To describe long-term progression or regression within individuals over time;
2. To determine whether overall prevalence rates and severity change with time after surgery;
3. To assess the long-term impact on every day activities and quality of life;
4. To determine whether the patterns of symptoms associated with particular sub-types of surgery and patient groups change over time.

### **Material & Methods:**

Approval was secured from the Newcastle and North Tyneside Local Research Ethics Committee and the study was sponsored by Newcastle upon Tyne Hospitals NHS Trust and the University of Aberdeen.

#### Census of cohort

We checked hospital records and death registers to identify members of the original 153 cohort participants who had died. Follow up status and current address of the remaining participants were then established from hospital records.

#### Definition of the cohort

In line with our previous report, patients were classified into four procedure groups: 1, ileal conduit diversion (n = 43); 2, bladder reconstruction (clam enterocystoplasty) for idiopathic detrusor overactivity (n = 17); 3, bladder reconstruction for neurogenic bladder dysfunction (n = 18); and 4, bladder replacement for a non-neuropathic condition (n=18).

For patients with detrusor overactivity having a clam enterocystoplasty (Group 2), 25 cm of terminal ileum was used. 13 patients in Group 3 had a standard clam enterocystoplasty using 25 cm of terminal ileum whilst the remaining 13 patients were reconstructed using a 30 cm ileocaecal segment on average. For patients in Group 4, 25 patients had an ileocecal segment (ileum – 20 cm; ascending colon – 20 cm), two patients had an ileal segment and one patient was reconstructed using colon only.

### Questionnaires

Each living cohort member was sent a bowel symptom questionnaire and generic quality of life questionnaire (Nottingham Health Profile; NHP) for self-completion; these had the same format as the previous study <sup>1</sup> to allow direct comparison over time. The symptom questionnaire included items on frequency of defecation, stool consistency, nocturnal diarrhoea, flatus leakage, faecal urgency and incontinence, and explosive diarrhoea. For the purposes of this study, more than two loose or watery bowel movements daily or any daily loose bowel movements daily whilst on anti-diarrhoeal medication was regarded as abnormal. The impact of bowel symptoms on work, social life, and sex life was also evaluated using a separate questionnaire <sup>1</sup>.

The NHP is a validated self-administered questionnaire designed to measure individual perceived health status <sup>10</sup>. It has six sections dealing with sleep, energy, emotional reactions, social isolation, physical mobility and pain. Each score has a minimum value of 0 - no perceived problems or difficulties in this area - and a maximum value of 100 - highest level of difficulty. As is common in measures of reported morbidity, scores on the NHP in 'normal' populations have been found to vary with age and sex. To allow comparison of our findings with a 'normal' population who had not had reconstructive surgery, we used age and sex matched norms for the NHP, based on aggregated data from 5 random samples representing more than 6,500 Britons <sup>11</sup>. An independent researcher (BS) who was not a member of the

surgical team treating the patients nor involved in the original study analysed the postal questionnaire survey.

#### Statistical analysis

Simple descriptive statistics were used to display differences between surveys. Differences between bowel symptoms at both time points were tested using McNemar's test. For the comparison of within patient NHP scores a paired t-test was used. A significance level of 5% was used for all tests.

#### **Results:**

Thirty (19.6%) of the original cohort were found to have died between 1997 and 2005. The progress on the remaining 123 is detailed in the flow chart (Fig 1). Within patient changes in prevalence of bowel symptoms are shown in Table 1; a summary of bowel symptoms reported in 1997 and then in 2005 is presented in Table 2; and impact on social, sex and work life is summarised in Table 3. The indications for surgery for the four groups were described in our previous publication<sup>1</sup>.

#### ***Within patient change in prevalence of bowel symptoms***

Data describing each of the five main bowel symptoms were available at both time points for between 45 and 90 participants (Table 1). Between 55% (flatus leak) and 24% (bowel opening at night) had bowel symptoms at one or both time points. There were no statistically significant differences between the two time points in the numbers who had symptoms. Of those with symptoms in 2005, the proportions who had also had the symptom in 1997 was around 50%, although this estimate did vary non-significantly between the symptoms. There was no correlation between length of bowel segment used and degree of bowel dysfunction.

### ***Prevalence of bowel symptoms amongst all respondents in the four patient groups***

There were no significant differences in the patterns of symptoms between the two time points, with the high prevalence rates observed at the first follow-up persisting after eight years (Table 2). Again, patients with a clam enterocystoplasty for bladder over-activity (Group 2) reported markedly high incidence of diarrhoea (59%; 10/17), flatus leakage (41%; 7/17), faecal urgency (41%; 7/17), explosive diarrhoea (46%; 6/13), nocturnal bowel movement (18%; 3/17), and faecal incontinence (47%; 8/17): 24% regretted having had surgery because of bowel symptoms they associated with their operation.

Patients who underwent bladder reconstruction because of neurogenic bladder dysfunction (Group 3) also continued to report high rates of troublesome bowel symptoms: diarrhoea (50% 9/18), flatus leakage (72%; 13/18), and faecal urgency (53%; 9/17). 18% (3/17) regretted having had surgery because of bowel symptoms they associate with their operation.

Although bowel dysfunction symptoms were still reported in Group 1 (ileal conduit diversion) and Group 4 (bladder replacement for non-neuropathic causes) at rates similar to those observed in 1997, patients in these groups were less affected than Groups 2 and 3 (Table 2). None of the 18 in Group 4 and 5% (2/42) in Group 1 regretted having had surgery. The number of patients managed with oral anti-diarrhoeal medications were as follows: group 1 (n = 10), group 2 (n = 4), group 3 (n = 6) and group 4 (n = 5).

### ***Impact of bowel symptoms on social, work and sex life***

There was little evidence of a change in the impact of bowel symptoms on aspects of everyday life. Patients with a clam enterocystoplasty for bladder over-activity (Group 2) reported the highest impact on social life (50%; 8/16), work life (36%; 5/14) and sex life (43%; 6/14). Patients with bladder reconstruction for neurogenic bladder dysfunction (Group 3) were the next most affected with about a third reporting moderate or severe impact on their



social, work and sex life. Groups 1 and 4 were the least affected (comparable rates around 15%; Table 3).

### ***Impact on overall Quality of life***

Figure 2 summarises the scores for the six components of the NHP at the two time points for the four groups (high scores indicate poorer quality of life). Patients with a clam enterocystoplasty for bladder over-activity (Group 2) and those with bladder reconstruction for neurogenic bladder dysfunction (Group 3) continued to report a poorer quality of life than those in Groups 1 and 4, and significantly worse than age and sex matched norms. Whilst the mean scores in Groups 1, 3 and 4 tended to be higher (poorer) in 2005, none of these differences was statistically significant. The mean scores for patients with clam enterocystoplasty for bladder over-activity (Group 2) were improved in all domains, but these differences were statistically significant only in the domains of energy and emotion (energy:  $p=0.02$ ; emotion:  $p=0.041$ ). The quality of life scores of ileal conduit diversion patients (Group 1) and non-neurogenic bladder reconstruction patients (Group 4) were similar to age and sex norm scores.

### **Discussion:**

#### *Principal findings and meaning of the study*

The results of this study show that altered bowel habit persists in the long term following transposition of segments into urinary tract. Despite more than ten years elapsing since surgery, operations involving transposition of intestinal segments continue to be associated with high rates of bowel symptoms, which negatively impact on everyday activities. These symptoms are particularly troublesome following enterocystoplasty for overactive bladder and bladder reconstruction for neurogenic bladder dysfunction with more than half of all such patients reporting diarrhoea. Both groups also continued to report troublesome diarrhoea-associated symptoms including faecal urgency, explosive diarrhoea, nocturnal bowel

movements and faecal incontinence. Since the last report, there has been no significant improvement in overall bowel symptoms in these two groups with 24% of clam enterocystoplasty patients and 18% of neurogenic bladder dysfunction patients regretting having surgery as a result. As when first assessed eight years previously, ileal conduit diversion patients and bladder replacement patients for non-neurogenic causes were less troubled with bowel dysfunction, although a substantial minority still had problems. This study also showed that bowel symptoms continue to have a detrimental impact on patients' every-day social, work and sex life; the clam enterocystoplasty patients being most affected followed by patients with neurogenic bladder dysfunction. Clam enterocystoplasty patients (Group 2) and neurogenic bladder dysfunction patients (Group 3) also reported the poorest overall quality of life scores.

#### *Strengths and limitations of the study*

The validity of our findings and strength of the study is its prospective design with long follow-up. This allowed prevalence rates to be estimated within circumscribed populations of patients at two time points; by using the same instruments, symptom changes could be tracked within individuals over time. As would be expected given the nature of the underlying problems, a high proportion of the original cohort (19.6%) had died. The response rate amongst survivors was high (83%), despite the long period between the two assessments protecting the generalisability of the findings. The main limitation is the size of the subgroups of cohort and hence the lack of precision around estimates of differences over time or between groups. In making comparisons of prevalence between the two time points, we chose to concentrate on within-patient analyses (Table 1), as these are least prone to bias. However, this further reduced the sample size as data from both 1997 and 2005 were not available for all participants. A consequence of the limited sample size is that we may have falsely ascribed real differences to chance. Nevertheless, the patterns of results seen at the first follow-up have persisted and this provides some protection from this. Follow-up was through postal questionnaires. A possible disadvantage is that this approach might have

missed aspects of morbidity that would have been identified at a face-to-face assessment. However, using postal questionnaires avoided bias introduced by the presence of a clinician. To further ensure that 'clinician bias' was avoided, all aspects of the study were undertaken by people who had no involvement in past or current clinical care. The main reasons for choosing to use the NHP again, despite the fact that it is now less commonly used than some other health status measures, is that it is validated, it performed well at the first assessment, and, most importantly, it allowed within patient comparison over time.

A potential limitation is that we cannot simply assume that transposing bowel segments into the urinary tract is a cause of the bowel dysfunction. What can be said is that there are strong associations between particular subgroups and a higher risk of diarrhoea. A plausible alternative explanation for patients with neurogenic bladder dysfunction is that the underlying neurological abnormality, which is known to affect the gastrointestinal tract such as in Spina bifida patients, may have contributed to the symptoms. For patients having clam enterocystoplasty for overactive bladder, there is evidence that such patients have a higher incidence of irritable bowel syndrome and therefore are at an increased risk of bowel dysfunction after transposed intestinal segment surgery <sup>12</sup>.

*Strengths and weaknesses in relation to other studies, discussing particularly any differences in results*

Our group recently reported a comprehensive systematic review of published research on bowel dysfunction after transposed intestinal segment surgery. We found few high quality studies, with most reports being retrospective, tending to report only diarrhoea and not the potentially more troublesome diarrhoea-associated symptoms described in this study <sup>2, 13</sup> in their group of clam enterocystoplasty patients for detrusor over-activity reported impaired outcome even though irritative bladder symptoms improved with surgery and concluded that this was due to long-term complications such as urinary tract infections and bowel

dysfunction. Singh and Thomas <sup>14</sup> compared 69 patients who had neurogenic bladder dysfunction with 44 patients who did not, and reported that 30% had long-term bowel dysfunction in both groups. Henningsohn et al <sup>15, 16</sup> reported diarrhoea and faecal leakage in 30% and 9% of cystectomy patients respectively 11 years after surgery. The same group also reported moderate to severe distress due to bowel symptoms in 22% of ileal conduit diversion patients, 21% of continent diversion patients, and 14% of bladder replacement patients <sup>15</sup>.

### *Implications of the findings*

This study offers for the first time reliable insight into not only the likelihood of developing bowel symptoms after intestinal transposition surgery but also the chances of symptoms persisting for some years after surgery. It has shown that bowel symptoms continue to have a major impact on many patients' lives that persists long after the surgery. Some types of patients, particularly those whose underlying condition is benign appear to be at particularly high risk and this raises questions about when intestinal transpositional surgery is appropriate in these groups. For all potential patients, our findings will allow better informed consent and help in the decision-making process for patients.

The nature of the problem that led to surgery in the first place is likely to influence the impact of bowel symptoms and this should be taken into account in interpreting these results. There might, for example, be a disproportionate effect on patients with a neurological problem. Patients with clam enterocystoplasty for bladder overactivity (a benign condition not associated with physical disability) might have the expectation of normality after surgery and hence the perceived impact on quality of life might be greater. The impact could also reflect a patient's adjustment to his or her own emotions and circumstances over time. The amount of distress depends not only on symptom frequency, duration and intensity <sup>17</sup> but also on coping ability. Coping ability in turn is influenced by age and personality, future expectations, lifestyle, attitude and co-existing symptoms. Enhanced counselling might therefore lessen the impact of bowel dysfunction on patients' social life, work life, sex life and quality of life.

### *Unanswered questions and future research*

While bile acid malabsorption and decreased intestinal transit time may be important factors in the development of bowel dysfunction after ileal or ileocaecal reconstruction, it is clear that they are not the only important contributing factors in patients with clam enterocystoplasty for overactive bladder. If they were, we would have expected such patients to have a lower incidence of bowel disturbance compared with those who underwent ileocaecal reconstruction. Therefore, the higher incidence of bowel dysfunction in patients with overactive bladder suggests an underlying predisposition that may be exacerbated by alterations in bile acid metabolism and intestinal transit time. That will certainly be the case in patients with neurogenic bladder dysfunction. There is a recognised association between overactive bladder and irritable bowel syndrome in up to 30% of patients supporting the hypothesis that there is an intrinsic disorder of smooth muscle in bladder and colorectum or in the nerve supply to the bladder and gastrointestinal tract<sup>18-21</sup>. That said, the reasons why some patients develop troublesome bowel symptoms and others do not remain unclear. Due to the potential risk of recall bias with the original study eight years ago, it has not been possible to gain insights into potential at risk factors prior to surgery within the four clinical groups. Future studies should at least be protocol driven prospective studies, and the impact of better pre-operative counselling on outcomes and quality of life should be assessed.

### **Conclusion:**

Patients considering bladder surgery involving transposition of intestinal segments into the urinary tract should be warned of the long-term risk of bowel dysfunction especially those with an overactive bladder or neurogenic bladder dysfunction. Only by better selection and improved counselling can the adverse impact on social functioning and overall quality of life be lessened. Patients should be warned that troublesome bowel symptoms commonly persist amongst those who develop bowel symptoms after surgery.



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**Table – 1:** Within patient change in prevalence of bowel symptoms over time (All Groups)

	Diarrhoea N = 88	Flatus leak N = 74	Faecal urgency N = 85	Explosive diarrhoea N = 45	Bowel opening at night N = 90
Asymptomatic at both time points	54 (61.6%)	33 (44.6%)	48 (56.4%)	27 (60.0%)	68 (75.5%)
Symptomatic at second time point only (within last 8 years)	12 (13.6%)	17 (23.0%)	10 (11.8%)	7(15.5%)	10 (11.1%)
Symptomatic at first time point only (8 years ago)	6 (6.8%)	9 (12.2%)	10 (11.8%)	4 (9.0%)	7 (7.9%)
Symptomatic at both time points	16 (18.0%)	15 (20.2%)	17 (20.0%)	7 (15.5%)	5 (5.5%)

**Table – 2:** Incidence of bowel symptoms in different patient groups in 1997 and 2005.

<b>Bowel Symptoms</b>	<b>Ileal conduit</b>		<b>Clam – Detrusor instability</b>		<b>Neurogenic bladder dysfunction</b>		<b>Other reconstructions</b>	
	1997	2005	1997	2005	1997	2005	1997	2005
Diarrhoea	8/68 (12%)	8/43 (19%)	19/28 (68%)	10/17 (59%)	11/25 (44%)	9/18 (50%)	4/28 (14%)	3/18 (17%)
Flatus Leakage	21/68 (31%)	16/43 (37%)	14/28 (50%)	7/17 (41%)	13/24 (54%)	13/18 (72%)	7/28 (25%)	6/18 (33%)
Faecal Urgency	9/64 (14%)	10/42 (24%)	16/27 (59%)	7/17 (41%)	14/23 (61%)	9/17 (53%)	3/8 (38%)	3/18 (17%)
Explosive diarrhoea	6/49 (12%)	10/42 (24%)	11/24 (46%)	6/13 (46%)	8/18 (44%)	6/17 (35%)	6/26 (23%)	2/18 (11%)
Bowel opening at night	8/69 (12%)	4/41 (10%)	6/28 (21%)	3/17 (18%)	4/25 (16%)	7/17 (41%)	2/28 (7%)	1/18 (6%)
Faecal Incontinence	10/65 (15%)	7/41 (17%)	13/26 (50%)	8/17 (47%)	8/22 (36%)	10/18 (56%)	5/27 (19%)	2/12 (17%)
Regret surgery	5/67 (7%)	2/42 (5%)	8/28 (29%)	4/17 (24%)	1/24 (4%)	3/17 (18%)	1/24 (4%)	0/18

**Table – 3:** Impact of bowel symptoms on social, work and sex life

Moderate/Severe impact of Bowel Dysfunction on	Ileal Conduit 1997	Ileal Conduit 2005	Clam-DI 1997	Clam-DI 2005	Neuro-genic 1997	Neuro-genic 2005	Bladder replacement 1997	Bladder replacement 2005
<b>Social life</b>	9/45 (20.0%)	6/39 (15.3%)	19/25 (76.0%)	8/16 (50.0%)	16/23 (69.5%)	7/18 (39.0%)	7/21 (33.3%)	2/17 (11.8%)
<b>Work</b>	5/39 (12.8%)	5/35 (14.3%)	15/23 (65.3%)	5/14 (35.8%)	8/18 (44.5%)	5/15 (33.3%)	2/18 (11.1%)	0/13
<b>Sex life</b>	10/35 (28.5%)	4/32 (12.5%)	10/23 (43.5%)	6/14 (42.9%)	6/21 (28.5%)	5/17 (29.4%)	2/16 (12.5%)	2/12 (16.7%)