

## Bowel dysfunction in spinal cord injury patients: pathophysiology and management

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**Summary:** Digestive function is one of the greatest problems for people with spinal cord injuries, particularly control of evacuation. The term “neurogenic bowel” is an indication of the belief that bladder emptying and evacuation of the rectal contents are thought to be similar. There are many important differences between the two functions that make the respective pathophysiological mechanisms underlying the symptoms quite different. Firstly, the muscular wall of the bladder does not contain a complex neuronal network. Secondly, the contents of the bladder are liquid while bowel contents can range from liquid to solid. It is impossible to explain variations in the transport of intraluminal contents based on a single pathophysiological model such as hyporeflexia/hyperreflexia or reduced/increased rectal wall compliance. In spinal cord injury patients intestinal transport of intraluminal contents through the colon is increased and the lesion level is not predictive of the motor activity of the large bowel. It is misleading to talk about the diagnosis and treatment of voiding and evacuation as if they behave in similar ways due to a neurological lesion.

**Key words:** Spinal cord injury; Visceral disorders; Neurogenic bowel; Bowel management.

### INTRODUCTION

Digestive function is one of the greatest problems for people with spinal cord injuries, particularly control of evacuation. Bowel disorders play an important part in the course of rehabilitation following spinal injury, in terms of both quality of life<sup>1,2</sup> and morbidity and mortality.<sup>3,4</sup> In a recent study in a large population of Italian patients with spinal cord injury (SCI) (993 subjects), 23% said they were not satisfied with their bowel management: more than half the sample said that it was a heavy burden on their social life and more than a third complained that they had not managed to achieve regular bowel function, that they were embarrassed and that they were not self-sufficient in managing their bowels.<sup>5</sup>

The approach to bowel problems in these patients has been developed from the approach used to study the bladder and voiding. The term “neurogenic bowel” is an indication of the belief that the two functions of bladder emptying and evacuation of the rectal contents are similar. However, there are many important differences between the two functions that make the respective pathophysiological mechanisms underlying the symptoms quite different, and the authors therefore feel that for a better clinical understanding, both conditions should be kept quite separate and the differences pointed out, rather than looking for similarities. The most important difference between the gastrointestinal tract and the bladder is the fact that the muscular wall of the bladder does not contain a complex neuronal network of the type that runs along the whole length of the gastrointestinal tract. The detrusor muscle and ureteral sphincters contract or relax in response to extrinsic nerve stimuli induced by reflexes and modulated by the central nervous system (CNS). However, it is well-known that the enteric nervous system is autonomous of both the CNS and autonomic nervous system, sufficiently so to be referred to as “the second brain”, and the contractile activity of the bowel wall muscles is not dependent on extrinsic stimuli; co-ordinated motility is preserved in the bowel even when the latter is completely denervated.<sup>6</sup> A second important difference between the physiology of bladder emptying and that of rectal emptying is the way in which both organs are filled. First there is the consistency of the contents: the contents of the bladder are invariably liquid, while faeces can be anything from semi-liq-

uid to decidedly solid, with variations even within the same material evacuated in the same defecation. In addition, urine flows into the bladder almost continuously, while there is considerable variation both in the intervals between times when the rectum is filled, and how long this takes (it should be remembered that the rectum is physiologically empty except during defecation). Normal bowel physiology is characterised by extreme variability and can be influenced by a number of factors. It is not surprising that the presence of any pathology in the rectum can result in even more variation in bowel function. If the rectum is inflamed and sensitive then it will react differently and may empty precipitantly in response to the arrival of small volumes of material from the left colon and minimal distension of the rectal walls. For these different reasons, the pathophysiological mechanisms underlying voiding and defecation disorders cannot be the same or similar, either in relation to excessive retention, or incontinence. One consideration will illustrate this general point: the majority of patients with complete SCI that has caused a total sensory and motor deficit of the anorectal region, do not experience seepage or unexpected evacuation. This is mainly because at the same time, the consistency of the faeces in these patients is increased, a fact that tends to prevent the material leaking; so faecal retention occurs even though the mechanisms of continence are completely absent. This phenomenon is not possible for the bladder; if sphincter tone is completely absent, even if there is no detrusor contraction, leakage of urine and incontinence occur.

In addition to water, the faecal volume consists of bacteria that “detach themselves” from the enormous amount of microflora present in the colon. In fact, more than 70% of the dry weight of faeces consists of bacteria, mostly living.<sup>7</sup> The remainder consists mainly of a matrix of undigested polysaccharides. The right colon contains a real “metabolic organ” formed from a biomass of bacteria, three times more numerous than the eukaryotic cells that make up our organism, formed from 400 different types of bacterial species which are the source of the bacteria eliminated as faeces, and which also have innumerable metabolic functions, including some that are able to significantly influence regulation of the motility of the colon in which they live.<sup>8,9</sup>

Thus, for all these reasons it seems misleading to continue to discuss the pathophysiology and, especially, diagnosis

and treatment of voiding and evacuation as if they behaved in similar ways as a direct consequence of the characteristics (level, completeness, etc.) of the neurological lesion of the central or peripheral nervous system. Rather than the term “neurogenic bowel”, we will use the more accurate “bowel dysfunction”, which is also more appropriate because impaired epithelial permeability, contractility and perception of abdominal organs are also present in those patients who have no particular intestinal disorders.

#### ABNORMALITIES OF COLORECTAL MOTILITY AND THEIR CLINICAL CONSEQUENCES

In 1984, Glick and co-authors published a study that demonstrated that the so-called “gastrocolonic reflex”, now more appropriately called the “colonic response to food” was no longer present after a thoracic spinal cord injury.<sup>10</sup> Recently, a group of American researchers demonstrated in eight SCI patients (three tetraplegics and five paraplegics, with lesion levels between C5 and T10) that the motor activity of the colon increased after ingestion of a meal of 880 kcal. This motor response involved only the descending colon and started from significantly lower levels of contractility than those of normal subjects.<sup>11</sup> So it seems certain that, after spinal cord injury, there is a reduction in both baseline colon motility and motility after stimulation, although the hypomotility does not uniformly affect all segments of the colon and is not related to the level or completeness of the injury. Consequently, the effects on transport of the intraluminal contents cannot be restricted to a single pathophysiological model such as hyporeflex-hyperreflex or reduced-increased wall compliance. Bowel transit studies confirm that the transit time of intraluminal contents through the colon is increased; in particular, transit time always increases in the transverse colon and descending colon, while in the other segments, increased transit time is related either to lesion level or to distance from the lesion event. A significant increase in transit in the rectosigmoid colon is in fact seen only in the case of lesions below the conus medullaris, while in the ascending colon it is seen only in the early stages after injury.<sup>12,13</sup> The fact that the lesion level is not predictive of the motor behaviour of the large bowel is also confirmed by our recent observations that demonstrated identical behaviours in tetraplegic and paraplegic patients, or more diverse behaviours within the same group.<sup>14,15</sup> In particular we found low rectal compliance in patients with both complete and incomplete cervical and thoracic lesions.<sup>16</sup>

It is thought generally that complications secondary to bowel dysfunction do not have the same impact in terms of severity and frequency as those resulting from bladder malfunction. In fact, many complications are caused by the faecal retention resulting from reduced frequency of evacuation, and especially by poor or incomplete evacuation that results in large amounts of residual material after evacuation. In fact, bowel dysfunction leads to many complications, Table 1 shows those that have been reported, with their respective references to the literature, but, in our judgement, improved knowledge of the pathophysiology and more refined diagnostic processes will result in an increase in the number of complications, showing that they have a completely secondary role in the clinical course of spinal cord injury.

In our opinion, there is already sufficient clinical evidence to classify as one of the most common and important complications in terms of clinical outcome, the manifestation of systemic inflammatory response syndrome (SIRS) caused specifically by faecal retention in the bowel from massive overgrowth of the bowel microbiota, as a conse-

quence of the dysmotility, altered epithelial permeability, and ingestion of drugs, that characterise the early stages after spinal cord injury.

Table 1: – Complications of fecal impaction in patients with spinal cord injury.

VOLVULUS	Longo WE, 1990 <sup>17</sup> Binard JE 1992 <sup>18</sup>
PARALYTIC ILEUS	Nino-Murcia M 1990 <sup>19</sup>
STERCORAL PERFORATION	Banwell JG 1993 <sup>20</sup>
AUTONOMIC DYSREFLEXIA	Cosman BC 1991 <sup>21</sup> Stone JM 1990 <sup>22</sup>
DYSPNOEA	Stone JM 1990 <sup>22</sup>
WORSENING OF SPASTICITY	Aisen ML 1992 <sup>23</sup>

Systemic inflammatory response syndrome (SIRS) is defined as the first stage of septic disorders, followed by sepsis, severe sepsis, septic shock, organ dysfunction associated with severe sepsis and septic shock, and finally multiple organ dysfunction syndrome (MODS), in accordance with the definitions and classification of the American College of Chest Physicians and the Society of Critical Care Medicine.<sup>24</sup> SIRS can be diagnosed when two or more of the following four criteria are present: axillary temperature > 38° or < 36°; leukocyte count > 2,000/mm<sup>3</sup> or < 4000mm<sup>3</sup>; heart rate > 90 beats/minute; respiration > 20/min or PaCO<sub>2</sub> < 32 mmHg.

To our knowledge no studies have clearly defined the relationship between faecal impaction, retention of faeces in the colon and the origin of the clinical manifestations that can be ascribed to SIRS, but they are very frequently observed in spinal units and in wards with acute patients. Moreover, there are many reasons to support such a relationship, including our knowledge of the incidence of bacterial overgrowth that occurs in the bowel of patients in intensive care in general, and in SCI patients in particular; and there is also the presence of epithelial hyperpermeability in these patients and the possibility of translocation that may be activated by disruption of the balance of intestinal bacterial flora. There are therefore strong arguments to support the theory that many cases of SIRS observed during the early stages after spinal cord injury are not the result of unrecognised foci of infection, but are rather caused by contamination and overgrowth of bowel microflora following motor dysfunction and incomplete bowel emptying.

A recent study in a population of patients with severe constipation who did not have motor neurological injuries demonstrated that many indicators of a systemic inflammatory response were present and that robust therapy with laxatives restored these indicators to normal. In particular, coinciding with poor evacuation there was a rise in the population of CD+3, CD+4 and CD+25 lymphocytes; there were also increases in serum albumin and in antibodies against *Streptococcus aureus* and *Escherichia coli*, with a simultaneous reduction in CD+27 and B-lymphocyte counts. Finally, there was a reduction in faecal concentration of bifid and lactic acid bacteria. Taken together, all these factors indicate that constipation disrupts the balance of the bacterial flora resident in the colon, with overgrowth of certain strains leading to activation of the systemic immunological control systems. All these values returned to normal after treatment with laxatives and the consequent resolution of faecal retention.<sup>25</sup> The suggestion that SIRS in patients with SCI may be related to faecal impaction is still a working hypothesis, but certainly these data offer strong support for it.

## ASPECTS OF THERAPY

The objectives of treatment of constipation should be to:

- allow the formation of a faecal mass of adequate volume and consistency;
- encourage the mixing of the intraluminal contents by regularising the 24-hour segmental contractile activity of the colon;
- stimulate the onset of propulsive motility;
- achieve suitable rectal filling to trigger the mechanisms of evacuation;
- promote complete evacuation avoiding post-defaecation residual faeces.

As stated previously, we do not have enough knowledge of the pathophysiological mechanisms to know how to achieve these effects in an SCI patient. However, there is certainly evidence and rational arguments for using substances such as Macrogol, prebiotics and probiotics in order to achieve these objectives, including in subjects with CNS lesions. The strategy we propose for a gradual approach to treating constipation is described below.

**Step 1:** *balancing the diet, with a return to normal relationships between fats, proteins and carbohydrates; wide range of foods consumed and the way they are prepared; incorporation of calories and with particular nutrients to correct any deficiencies or malnutrition; administration of prebiotics and dietary fibre; weaning from oral laxatives; scheduling of evacuation with Dulcolax suppositories (or suppositories for evacuation, if sufficient) every two to three days with the patient on the toilet, and not lying on their side in bed.*

If these measures do not succeed in achieving satisfactory rectal evacuation, either in terms of comfort and acceptability for the patient, or completeness and ensuring continence, a full gastroenterological assessment should be carried out, followed by a move to **step 2**, i.e. *using more specific and more powerful products and drugs, from Macrogol to high doses of psyllium, prokinetics, digestive enzymes and many others<sup>26</sup> in different combinations for an individualised treatment plan related to the problems found in that patient.* If this approach is also not sufficient, we move on to **step 3**, *starting the patient on transanal irrigation performed with the new Peristeen® device (Coloplast, U.S.A.).* This is a simple device consisting of a rectal catheter fitted with a balloon which, once inflated, maintains complete continence in the region of the anal sphincter. This makes it possible to infuse 800-1000 ml of water in a few minutes, using a hand pump; the pressure exerted means that it will irrigate even the proximal segments of the colon. At the end of infusion, as soon as the catheter has been removed, the increased intraluminal pressure causes the water and faeces to be evacuated. We have shown that even the contents of the right colon are evacuated after a single irrigation session with this device.<sup>27</sup> A multicentre study of a significant number of stabilised SCI patients, involving some of the most important spinal cord units in Europe, showed that bowel function indicators (better quality of life and reduced number of urinary infections) were better in the group treated with this method than in the control group, which was treated with traditional methods.<sup>28</sup>

## CONCLUSION

Instruments to explore bowel function in spinal cord injury are now available in more advanced centres and in specialist spinal units, i.e. multichannel anorectal manometry, study of transit with radiopaque markers or scintigraphy, computerised barostat measurement, and dynamic radio-

logical studies with defaecography or MR defaecography. Total colonic manometry and gastroduodenojejunal manometry are now well-established techniques by which we can discover the precise mechanisms that allow the bowel to function after a CNS lesion. Systematic use of these studies makes it possible to identify the various pathophysiological mechanisms that may cause apparently identical clinical situations. Just as in functional gastrointestinal disorders, including in SCI patients, it is important to determine the precise disorder (or disorders) causing the evacuation problems, and so to plan targeted therapy which is guided by the pathophysiology, rather than the invariably empirical therapy which is still too often given, even in the better spinal cord units.

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## Pelvic Floor Digest

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### 8 – FISTULAE

**Spontaneous closure of vesicovaginal fistulas after bladder drainage alone: review of the evidence.** *Bazi T. Int Urogynecol J Pelvic Floor Dysfunct.* 2007;18:329-33. A vesicovaginal fistula may occur as a surgical complication, the result of obstructed labor, or a late manifestation of radiotherapy. Surgical treatment includes many routes and techniques, with a success rate reaching 100%. The spontaneous closure of vesicovaginal fistulae following bladder drainage alone for varying periods has been reported by many, but the factors favoring the success of this conservative method have not been well examined and no solid conclusion regarding management recommendations can be drawn.

**Benign rectovaginal fistulas: management and results of a personal series.** *Devesa JM, Devesa M, Velasco GR et al. Tech Coloproctol.* 2007 May 25; epub. In 46 cases surgical techniques included endorectal or vaginal advancement flaps, fistulectomy and sphincteroplasty, vaginal/rectal closure and epiploplasty, restorative proctectomy and restorative proctocolectomy. In 20 patients, a diverting stoma was performed as a single procedure or concomitant to the curative attempt. Overall 85% treated for cure healed, including all simple fistulas and 20 complex fistulas (8 iatrogenic, 3 actinic, 2 ulcerative colitis without restorative procto-colectomy; 5 pouch vaginal; 1 septic; 1 Crohn's disease).

**Recto-urethral fistula following brachytherapy for localized prostate cancer.** *Shakespeare D, Mitchell DM, Carey BM et al. Colorectal Dis.* 2007;9:328-31. The incidence of recto-urethral fistula (RUF) is low. RUF following prostate brachytherapy has been associated with rectal biopsy in previous series and this is confirmed in our report. Gastrointestinal specialists should not perform biopsy of the anterior rectum in patients who have had brachytherapy unless there is a very high clinical suspicion of malignancy.

**Late results of treatment of anal fistulas.** *Sygut A, Zajdel R, Kedzia-Budziewska R et al. Colorectal Dis.* 2007;9:151-8. The aim of this paper is to analyse the results of treatment of anal fistulas retrospectively. The complication rate was 10-fold higher in patients presenting with a recurrent fistula than in those with primary fistulas and threefold higher in patients with multi-tract fistulas than in those with single-tract fistulas.

**Anal Sphincter Advancement Flap for Low Transsphincteric Anal Fistula.** *Chew SS, Adams WJ. Dis Colon Rectum.* 2007 Apr 27; epub. A new technique proposes the use of the distal part of the anal sphincter as an advancement flap to cover the internal opening and thereby effect a cure.

### 9 – BEHAVIOUR, PSYCHOLOGY, SEXOLOGY

**Interstitial cystitis and female sexual dysfunction.** *Ottom DP, Carr LK, Perks AE, Lee P, Teichman JM. Urology.* 2007;69:608-10. Female patients with interstitial cystitis/painful bladder syndrome have sexual dysfunction, including pain. Female Sexual Function Index Pelvic Pain and Urgency/Frequency Questionnaire scores are considered.

**Erectile dysfunction.** *Wessells H, Joyce GF, Wise M, Wilt TJ. J Urol.* 2007;177:1675-81. Erectile dysfunction is self-reported by almost 1 of 5 men and it increases with age. Accurate estimates of economic cost will require better understanding of pathogenesis, treatment seeking behaviour, patient preference for therapies, success of treatments and relative satisfaction with oral pharmacotherapy and penile implants.

### 10 – MISCELLANEOUS

**Recurrent Postoperative Perineal Hernia: Transperineal Redo Mesh Repair.** *Tracy Hull, M.D., Editor. Ruiz DE, Khaikin M, Vivas D, Newman M, Wexner SD. Dis Colon Rectum.* 2007 Apr 27; epub. A technique is described of transperineal mesh repair of symptomatic perineal hernia recurrent after previous transabdominal mesh repair of the hernia developed after abdominoperineal resection.

**The utility of magnetic resonance imaging for diagnosis and surgical planning before transvaginal periurethral diverticulectomy in women.** *Foster RT, Amundsen CL, Webster GD. Int Urogynecol J Pelvic Floor Dysfunct.* 2007;18:315-9. The use of MR imaging allowed for accurate diagnosis and improved surgical planning: 26 women were treated with periurethral diverticulectomy, one with cystourethrectomy.