Research article

Bowel function and quality of life after colostomy in individuals with spinal cord injury

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Objective: To evaluate the effect of colostomy on bowel function and quality of life (QoL) in individuals with spinal cord injury (SCI).
Design: Cross-sectional descriptive study.
Setting: Department for Spinal Cord Injuries and Departments of Gastroenterology and Radiology, Rigshospitalet.
Participants: Eighteen individuals with SCI and a colostomy performed post injury, 12 males, 6 females, 8 with tetraplegia and 10 with paraplegia. Median age at time of study was 49.9 years, years since lesion was 3–56 years, and time since colostomy was performed 0.5 to 20 years.
Interventions: Questionnaires and measurement of gastrointestinal transit time (GITT).
Outcome measures: Retrospective data collection from patient records, a questionnaire on bowel management pre and post colostomy, quality of life (QoL) by SF-36, and GITT.
Results: Seventy-two percent significantly reduced their use of time on bowel emptying after the colostomy. All but one reported being content with the colostomy. Thirty-nine percent reported one or more problems related to the colostomy. Seventy-five percent had a GITT within normal range for able-bodied populations. When disregarding the physical component, QoL was not significantly lower in the total study group compared to a Danish norm group, but significantly lower when compared the subgroup of persons with tetraplegia.
Conclusion: A colostomy reduces the time necessary for bowel management. The majority of individuals with SCI and a colostomy did not perceive bowel management as being a problem. The results indicate that colostomy is a favourable option for individuals with SCI, who spend long hours on bowel management and for whom non-invasive procedures did not improve the situation enough.

Keywords: Spinal cord injury, Colostomy, Bowel management, Quality of life

Introduction

Persons living with spinal cord injury (SCI) have the onerous and time-consuming task of bowel management, and also periodically develop complications requiring interventions ranging from taking extra laxatives to surgery. The risk for complications is related to opioid[1] and anticholinergic use[2] and aging.[3,4] The problems related to bowel management are due to neurogenic bowel dysfunction resulting from SCI and includes faecal incontinence and difficulty with evacuation.[5–12] In a study by Menter *et al.*[13] including 221 long-term spinal cord injured, 42% reported constipation, 35% gastrointestinal pain, and 27% complained of bowel accidents. A previous study on128 patients with SCI by Harari *et al.*[14] showed that 73% had megacolon and 52% of these had associated radiological constipation. Megacolon was in that study defined as colonic dilatation of >6 cm in one or more colonic segments. Krogh *et al.*[15] reported that 42–95% of patients with SCI suffer from constipation and that faecal incontinence is experienced by 75%. The complications with bowel management may influence daily activities and lifestyle, which may lead to social isolation. Glickman

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et al.[6] earlier concluded that "bowel function is a major physical and psychological problem in spinal cord injured patients." In a Danish study,[16] 39% of the patients with SCI reported that colorectal problems had some or major influence on social activities or quality of life (QoL) and when asked to compare bowel complaints with bladder and sexual difficulties 30% regarded colorectal dysfunction as a greater problem than bladder and sexual dysfunction. Another study concerning QoL and traumatic spinal cord injury[17] showed that several medical complications including bowel problems were associated with lower QoL. Lynch *et al.*[18] concluded in a review on bowel dysfunction, that despite improved colonic motility and appropriate bowel management, some SCI patients have ongoing bowel problems and there is a need for further research into this topic.

A review by Simpson *et al.*[19] examined studies, that directly surveyed people with SCI to ascertain their health priorities and life domains of importance and found bowel to be one of the priorities and domains of importance. In rare cases individuals with SCI have a colostomy performed. There are no exact estimates available in the literature.

The aim of this study was to obtain and compare data on bowel management together with measurement of gastrointestinal transit time (GITT) and QoL in a group of individuals with SCI, who currently have a colostomy, which was performed after their SCI. Collection and comparison of all these data on the same group of individuals is to our knowledge unique.

Methods

The material consisted of individuals with SCI in contact with the Department for Spinal Cord Injuries (DSCI), and who had a colostomy performed after the SCI. Twenty-five individuals fulfilled the inclusion criteria at the time of the study. They were contacted by telephone and informed about the project and 18 accepted to participate in the project. The SCIs of the participants incurred between 1945 and 1995. 12 were males and 6 females, 8 had tetraplegia and 10 had paraplegia. Fifteen participants were American Spinal Injury Association Impairment Scale (AIS) A, one AIS C and two AIS D.[20] Mean age at the time of the study was 49.9 years (range 37–72 years). Mean time since SCI was 20.9 years (range 3–56 years) and mean time since colostomy was 6.9 years (range 6 months–20 years).

Retrospective data were retained from medical files. Further, an interview was conducted in relation to the regular follow-up of the participants including a questionnaire concerning bowel management pre- and post-colostomy (Table 2). In addition a QoL evaluation was performed using the Medical Outcomes Study Short Form 36 (SF-36) Health Survey.[21]

SF-36 is a validated health related QoL questionnaire with 36 items, which measures health in 8 different dimensions. Overall the evaluation can measure a physical health component and a mental health component. The Danish version of SF-36 is validated against a able-bodied Danish norm group of 4084 persons (48% males, age >16 years),[22] thereby enabling a comparison between the results of this study and normative data. The same physician performed all interviews.

Finally, the GITT was estimated[23] to measure the colon transit time at the time of the study. The measurement of GITT was performed by ingestion of capsules with different radiopaque markers daily for 6 days and on the 7th day an abdominal radiograph was taken. From the number of markers present in the various parts of the intestine, the GITT was calculated. The normal values for GITT in able-bodied populations using the described method are ≤70 hours for women and ≤60 hours for men.[23]

Statistical methods

The χ^2 test was used to compare time used on bowel management pre- and post-colostomy. The unpaired *t*-test to compare the QoL data in the colostomy group with the Danish SF-36 health survey normative data. Fisher exact test was used to compare individuals with para- and tetraplegia concerning GITT. The level of significance chosen was $P < 0.05$.

Results

Data on the participants in the study are presented in Table 1. The lowest lesion was Th12, and no one with a lower motor neuron bowel. Eleven had a complete SCI, 17 had a sigmoidostomy and one had a transverse colostomy.

Table 2 shows the answers of the participants to the various questions in the interview.

All together, 15 participants reported problems with bowel management (faecal incontinence and/or constipation) prior to having the colostomy performed.

The indication for having the colostomy performed was faecal incontinence and/or constipation in 11 of the participants. Six of the participants had the colostomy performed due to pressure ulcers or infection in perineum or lower abdomen, and one due to rectal cancer (Table 1).

Concerning daily use of time on bowel management five participants used the same amount of time pre-

Table 1 Information of the participants with spinal cord lesion (SCL) regarding gender, neurological level of the SCL, the AIS* grade, the type of colostomy performed, age at the time of the study, time since colostomy performed, time since SCL, gastrointestinal transit time (GITT) and the reported bowel emptying problems prior to the colostomy and reasons for having the colostomy. *N* = 18

Participant number	Sex	Neurological level of SCL	AIS* score	Type of colostomy	Age at the time of the study (years)	Time since colostomy was performed (years)	Time since injury (years)	GITT (hours) ⇑ = elevated	Bowel emptying problems prior to the colostomy	Reason for having the colostomy performed
1	M	TH11	A	Sigmoidostomy	50.1	0.5	5.6	n/a	n/a	Pressure ulcer in perineum
2	M	TH10	A	Sigmoidostomy	68.4	6.8	56.0	108.0 ⇑	Constipation	Ruptured colon due to constipation
3	M	C4	C	Sigmoidostomy	68.7	1.0	9.4	n/a	Faecal incontinence	Fistula in perineum
4	F	TH8	A	Sigmoidostomy	46.2	7.7	13.2	81.6 ⇑	Constipation	Constipation
5	M	C4	A	Sigmoidostomy	40.3	1.3	6.0	38.4	Constipation and faecal incontinence	Constipation
6	F	C5	A	Sigmoidostomy	40.4	3.7	10.8	12.0	Constipation and faecal incontinence	Faecal incontinence
7	F	C1	A	Sigmoidostomy	45.7	13.3	17.4	62.4	Constipation and faecal incontinence	Constipation and faecal incontinence
8	F	C5	D	Sigmoidostomy	45.3	1.2	6.0	7.2	Faecal incontinence	Faecal incontinence
9	M	TH4	A	Sigmoidostomy	43.2	9.7	20.7	120.0 ⇑	Constipation	Abscesses in perineum
10	M	TH2	A	Sigmoidostomy	37.1	8.2	10.3	12.0	Faecal incontinence	Faecal incontinence
11	M	C1	A	Sigmoidostomy	44.2	0.6	3.5	16.8	Constipation	Constipation
12	F	TH11	D	Sigmoidostomy	69.2	13.6	16.9	0.0	Faecal incontinence	Faecal incontinence
13	F	C4	A	Sigmoidostomy	52.1	20.4	27.0	48.0	Constipation	Constipation
14	M	TH11	A	Sigmoidostomy	72.1	1.1	36.6	19.2	Constipation and faecal incontinence	Faecal incontinence
15	M	Th12	A	Transverse colostomy	55.2	3.0	30.9	43.2	n/a	Infections in lower abdomen
16	M	C4	A	Sigmoidostomy	68.7	15.2	39.9	67.2 ⇑	Faecal incontinence	Rectal cancer
17	M	TH4	A	Sigmoidostomy	49.6	14.3	22.1	19.2	Faecal incontinence	Abscesses in perineum
18	M	TH9	A	Sigmoidostomy	67.8	2.3	44.4	36.0	n/a	Ulcer in perineum

F = Female; M = Male.
*American Spinal Injury Association Impairment Scale[20].

Table 2 Questionnaire concerning bowel management pre- and post-colostomy

1. Please describe your bowel emptying prior to the colostomy _____	
2. What was the reason for having the colostomy? _____	
3. Presently, how much time do you use on bowel management daily?	N = 18
☐ 0–15 min	n = 13 (72%)
☐ 16–30 min	n = 2 (11%)
☐ 31–60 min	n = 3 (17%)
☐ 61–120 min	n = 0
☐ More than 120 min	n = 0
4. Pre colostomy, how often did you perform bowel management?	N = 18
☐ 0–2 times a week	n = 1 (6%)
☐ 3–7 times a week	n = 13 (72%)
☐ More than 7 times a week	n = 4 (22%)
5. Pre colostomy, how much time average did you use on bowel management daily?	N = 18
☐ 0–15 min	n = 3 (17%)
☐ 16–30 min	n = 3 (17%)
☐ 31–60 min	n = 3 (17%)
☐ 61–120 min	n = 5 (28%)
☐ More than 120 min	n = 4 (22%)
6. Are there any problems with the colostomy?	N = 18
☐ Leakage problems	n = 2 (11%)
☐ Skin problems	n = 3 (17%)
☐ Odour problems	n = 2 (11%)
☐ Cosmetic problems	n = 1 (6%)
☐ Pain	n = 3 (17%)
☐ Emptying problems	n = 0
☐ Function problems	n = 1 (6%)
7. Do you perceive bowel management with a colostomy as being a problem?	N = 18
☐ Yes	n = 2 (11%)
☐ No	n = 16 (89%)
8. When comparing your bowel management prior to the colostomy, how is your bowel management now?	N = 17
☐ Better	n = 16 (94%)
☐ Unchanged	n = 0
☐ Worse	n = 1 (6%)
9. If possible would you prefer reversing the colostomy?	N = 18
☐ Yes	n = 1 (6%)
☐ No	n = 17 (94%)
10. Would you have preferred to have the colostomy performed earlier?	N = 18
☐ Yes	n = 12 (67%)
☐ No	n = 6 (33%)
11. Do you have concerns about longer transportation in relation to bowel management?	N = 18
☐ Yes	n = 3 (17%)
☐ No	n = 15 (83%)
12. Are you very dependent on easy access to toilets, when you are not	N = 18
☐ Yes	n = 2 (11%)
☐ No	n = 16 (89%)
13. Has the colostomy affected your social life?	N = 18
☐ Yes	n = 10 (56%)
☐ No	n = 8 (44%)
If Yes, please describe _____	

and post-colostomy and 13 participants significantly reduced their use of time on bowel management after the colostomy ($P = 0.004$). None of the participants increased the time used on bowel management after the colostomy (Table 3). Of the five participants with no change in time used on bowel management pre- and post colostomy, three participants had the colostomy performed due to other reasons than problems with bowel management. The latter two had the colostomy performed due to faecal incontinence and constipation, respectively.

Regarding the specific problems related to the colostomy as reported by the participants, seven participants reported one or more problems. Two participants reported having both leakage and skin problem and additionally odour problems for the one and cosmetic problems and pain for the other. These two participants both mentioned having a parastomal hernia. The remaining five participants only reported one problem each.

Concerning perception of bowel management post colostomy as being a problem, 16 participants answered

Table 3 Answers to questions concerning time spend on bowel management pre- and post colostomy at the individual level. *N* = 18

	Pre-colostomy		Post-colostomy
Participant number	How often did you perform bowel management per week?	How much time average did you use on bowel management daily?	How much time do you use on bowel management daily?
1	3–7 times	0–15 min	0–15 min
2	3–7 times	16–30 min	0–15 min
3	3–7 times	16–30 min	0–15 min
4	3–7 times	>120 min	0–15 min
5	3–7 times	31–60 min	0–15 min
6	3–7 times	61–120 min	0–15 min
7	0–2 times	>120 min	0–15 min
8	>7 times	>120 min	0–15 min
9	3–7 times	61–120 min	0–15 min
10	3–7 times	16–30 min	16–30 min
11	>7 times	>120 min	31–60 min
12	>7 times	61–120 min	0–15 min
13	3–7 times	0–15 min	0–15 min
14	>7 times	61–120 min	16–30 min
15	3–7 times	0–15 min	0–15 min
16	3–7 times	31–60 min	31–60 min
17	3–7 times	61–120 min	31–60 min
18	3–7 times	31–60 min	0–15 min

"no" to the question. The remaining two participants, both males, one having paraplegia with a transverse colostomy and the other tetraplegia with a sigmoidostomy both annotated the answer. The participant with paraplegia reported that the colostomy was unnatural and that he never expected to come to terms with it. The participant with tetraplegia reported noise from the sigmoidostomy as an explanation.

The participants were also asked to evaluate bowel management at the time of the project, compared to at the initial discharge from DSCI and 17 participants reported that bowel management currently was better than at discharge. One only found the function to be worse compared to initially. This participant (Participant number 3) reported that bowel management was not a problem prior to the colostomy, which was performed due to a fistula in perineum. The participant only had the colostomy performed one year prior to the present study and would not prefer reversing the colostomy if possible at the time of the study.

All but one answered "no" when asked if they would prefer to have the colostomy reversed, if possible. The participant who answered "yes" to reversion of the colostomy if possible, had the colostomy performed due to infection in the colon and did not have any bowel management problems prior to the colostomy. Furthermore, 12 participants reported at the time of the study that they would have preferred the colostomy/this treatment option had been offered at an earlier stage.

Fifteen participants reported not being concerned about bowel management, when they had to be transported over long distances. Of the three participants, who reported concerns when transported over long distances, two participants elaborated their answers and noted their concerns being (1) nervousness of possible leakage and (2) need for time and place to change the bag.

Sixteen of the participants claimed not to be very dependent on easy access to toilets when not at home.

Nine of the participants reported that the colostomy had a positive influence on their social life in relation to travelling more, seeing more people and saving time on bowel management, while eight did not report any influence on their social life and one reported a negative influence on social life due to limitations in how to dress, when need of hiding the colostomy (Participant number 15).

When comparing the scores from the QoL evaluation (SF-36) of the participants in this project with a able-bodied group of Danish individuals, the individuals with SCI and colostomy scored significantly lower concerning the physical health component ($P < 0.0001$) both as a whole group, and when divided by sex as well as when divided by paraplegia and tetraplegia and compared separately. Concerning the mental health component there was no statistically significant difference between the participants as one group or divided by gender and the able-bodied Danish group ($P = 0.08$). When dividing the participants by paraplegia and tetraplegia, the tetraplegic group scored significantly lower than the able-bodied Danish group concerning mental health component ($P = 0.04$), which was not the case for the paraplegic group ($P = 0.56$). It is important to be aware that these results are

based on a very limited number of participants in the paraplegic and tetraplegic groups, 8 and 10 participants respectively.

The GITT examination was performed in 16 of the 18 participants (Table 1). Of these, 15 participants had a sigmoidostomy and one participant had a transverse colostomy. Twelve participants, including the participant with transverse colostomy, had GITT within normal range for able-bodied populations. Two participants exceeded the normal range of GITT with less than 12 hours and the remaining two participants exceeded the normal range with more than 48 hours (Table 1).

Three of the four participants having GITT outside the normal range, all reported constipation as bowel emptying problem prior to the colostomy. The latter participant had faecal incontinence and the colostomy was performed due to rectal cancer.

All together five participants reported constipation prior to the colostomy, of these three participants had GITT outside normal range post colostomy.

When comparing the GITT results between individuals with paraplegia and tetraplegia concerning number of individuals within and outside normal range, there was no significant difference between the two groups ($P = 0.58$).

Discussion

Previous studies have shown that bowel function often is affected after an SCI.[5,6,10,18] Krogh *et al.*[15] showed, that SCI results in severely prolonged colonic transit times in the acute and chronic phase. In the chronic phase of SCI GITT was found to be 3.93 days for supraconal lesions and 3.61 days for conus medullaris or cauda equine lesions. Leduc *et al.*[24] compared colon transit time (CTT) in patients with SCI to a population of individuals without SCI and found a significant increase in total CTT and segmental CTT of the right and left colon in the group of SCI patients. In this study we investigated GITT after the colostomy was established. Twelve participants in the present study had a GITT within normal range after the colostomy. This finding could be due to the colostomy and may contribute to why the majority of the participants reported not perceiving their present bowel management as being a problem. The only proof for this would be improvements in pre- and post-colostomy GITT measured in a cohort of patients undergoing colostomy.

Of the five participants reporting constipation prior to the colostomy, three participants had a GITT outside normal range post colostomy. This could indicate that bowel management problems prior to colostomy predict prolonged GITT after colostomy.

A study by Media *et al.*[25] showed that radiographically determined GITT may be useful for comparison of groups of patients with SCI, but of limited value for clinical decision-making in individual patients.

When reading other studies concerning CTT in individuals with SCI different strategies are used to measure CTT. Leduc *et al.*[24] used in their study on CTT after SCI the Chaussadés technique. This technique implies ingestion of 20 radiomarkers per day for three days and an abdominal radiograph done on the fourth and seventh day and sometimes on the tenth day, if there were visible markers on the seventh day. The patients had an average of 2.3 abdominal radiographs done in the study.

In the study by Safadi *et al.*[26] radiomarkers were also used. Initially the first 16 patients ingested 20 radiopaque markers consisting of size 16F Silastic nasogastric tubes cut in segments 3-mm thick and mixed with breakfast food. Abdominal radiographs were obtained at 24-hour intervals until all markers were evacuated, or until 7 days had passed. The method to evaluate CTT was slightly modified over the course of the study towards only two abdominal radiographs altogether for each patient.

In the present paper the method we used was selected, because the patients only needed to have a single abdominal radiograph done. Presumably more radiograph examinations would provide a more precise result for the CTT, but given the fact that GITT measurement was an additional examination, that the patient did not need in the regularly follow-up, it was important to minimize the amount of X-ray for each patient.

Obviously it would have been very interesting if GITT also had been measured in the participants in the present study before the colostomy procedure. Unfortunately this was not the case.

The significant decrease found in time spent on bowel care after a colostomy is similar to the results of other studies.[26–32]

Altogether 7 participants in our study reported having one or more problems with the colostomy as seen in Table 2. The figures of each subgroup are not insignificant but not as pronounced as in the study by Coqgrave *et al.*,[28] which found a higher proportion of participants reporting problems in each subgroup compared to the present study. Still both studies showed high satisfaction with the colostomy and only a limited number of participants would prefer the colostomy reversed, if possible.

In the present study QoL was assessed with SF36, which has been shown to be a valid instrument, which should be considered for use in SCI QOL studies.[33]

In SF 36 QoL is described by both a physical and a mental component.[21] As expected the participants in the present study did score significantly lower than the able-bodied Danish group concerning the physical component, presumably due to the physical disability of the participants. But concerning the mental component either the total group of participants, or when divided by gender and the paraplegic subgroup did score significantly lower than the able-bodied Danish group. Only the tetraplegic subgroup scored significantly lower than the able-bodied Danish group. It is important to note, that the two subgroups only consisted of 8 and 10 participants respectively, a very limited number with which to calculate statistics.

Though possible in SF 36, it is not appropriate in the present study to compare within groups of age due to the very limited number of participants in each age group.

In accordance with our results Haran *et al.*[34] showed a lower score in the physical component summary (PCS) of spinal cord injured compared to the general population, but unexpectedly higher mental component summary scores (MCS).

Westgreen *et al.*[17] showed no difference in QoL assessed by SF 36, when comparing the 4 subgroups: complete and incomplete, paraplegic and tetraplegic.

Our results are partly in accordance to several previous studies, which have shown that colostomy improves QoL in individuals with SCI.[26,27,30,31,35]

In contrast Randall *et al.*[36] showed that QoL was not significantly different between spinal cord injured with or without colostomy. This is supported by Luther *et al.*[37] who showed no significant difference in persons with SCI with or without colostomy concerning QoL but large numbers of respondents in both groups reported being very unsatisfied with their bowel care program.

Being an invasive procedure with possible complications, a colostomy should only be performed when properly indicated. Lynch *et al.*[18] reviewed the different strategies in bowel dysfunction following SCI, and concluded that non invasive procedures are recommended as primary solutions followed by more invasive procedures when needed. Another review recommends an individualized person-centered bowel program, which may include diet, oral/rectal medications, equipment, and scheduling of bowel care as primary interventions in neurogenic bowel dysfunction after SCI.[32]

Having these recommendations in mind, it is important to choose the invasive procedures, when needed. This is also indicated by 12 of the participants in this study, who would have preferred the colostomy be performed earlier. This is further supported by other studies in which the large majority of participants with a colostomy did report a desire to be offered surgery earlier.[26–29,31]

The present study has several limitations, which are important to take into consideration when evaluating the results. The number of participants in the study is limited, as expected when a colostomy is only performed in a selected group of SCI patients and only when other less invasive methods have failed or no other alternative possible. The limited number of participants also characterizes other papers concerning bowel management in SCI individuals. In a review article from Cochrane Database Systematic Review[38] concerning management of faecal incontinence and constipation in adults with central neurological diseases, the authors concluded that it is not possible to draw any recommendation for bowel care in people with neurological diseases partly due to the size of trials. This is also one of the conclusions in the study by Pardee *et al.*[39] which presents interesting data on bowel management in individuals with SCI but due to the limited number of individuals in the study living with a ostomy it was not possible to extrapolate meaningful information.

The method chosen to measure GITT in the present study included only one X-ray for each participant, which was important for the safety of the participants, but might give more imprecise results and be a limitation to the study.

Further retrospective data collection has limitations as in this study. It would have been interesting if the participants had filled out the SF-36 and had the GITT performed prior to the colostomy was established, but that was not possible.

Concerning QoL it would also have been interesting to compare the results of the participants in this study to individuals with SCI without a colostomy additionally to the able-bodied Danish group, but this was not a part of the present study.

Medical data could be retrieved on all participants, who accepted to be included in the study and they all answered the questionnaires in the study. Sixteen of the participants had the GITT examination done. In conclusion the data presented can be considered reasonable representative for the study population.

The present study is important because there is still remarkable little research in this field as pointed by a recent review article,[40] which found limited evidence from individual trials in favour of several different treatments, but these findings needed to be confirmed by larger well designed controlled trials. Further a study by Anderson investigating the most important functions to the SCI population in regard to enhancing QoL,

found that improving bladder and bowel function was of shared importance to individuals with both paraplegia and tetraplegia.[41]

Conclusion

A colostomy reduces the time necessary to bowel management. The majority of individuals with SCI and a colostomy did not perceive bowel management as being a problem. The results indicate that colostomy is a favourable option for individuals with SCI, who spend long hours on bowel management and for whom non-invasive procedures did not improve the situation enough.

Disclaimer statements

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Conflicts of interest Patient consent forms have been collected from the participants prior to entering the study. All authors declare no conflict of interest. All authors have seen and approved the manuscript in the submitted form and agreed to submission.

Ethics approval The study has been approved by the Research Ethics Committee in Copenhagen (KF 01-111/01).

References

1 Dorn S, Lembo A, Cremonini F. Opioid-induced bowel dysfunction: epidemiology, pathophysiology, diagnosis, and initial therapeutic approach. Am J Gastroenterol 2014;2(1):31–7.
2 Metha D, editor. British National Formulary (v. 51). British Medical Association and Royal Pharmaceutical Society of Great Britain; April 20, 2006.
3 Frankel HL, Coll JR, Charlifue SW, Whiteneck GG, Gardner BP, Jamous MA, *et al.* Long-term survival in spinal cord injury: a fifty year investigation. Spinal Cord 1998;36(4):266–74.
4 Hartkopp A, Brønnum-Hansen H, Seidenschnur AM, Biering-Sørensen F. Survival and cause of death after traumatic spinal cord injury. A long-term epidemiological survey from Denmark. Spinal Cord 1997;35(2):76–85.
5 De LD, Van LM, De MM, Beke R, Elewaut A. Constipation and other chronic gastrointestinal problems in spinal cord injury patients. Spinal Cord 1998;36(1):63–6.
6 Glickman S, Kamm MA. Bowel dysfunction in spinal-cord-injury patients. Lancet 1996;347(9016):1651–3.
7 Han TR, Kim JH, Kwon BS. Chronic gastrointestinal problems and bowel dysfunction in patients with spinal cord injury. Spinal Cord 1998;36(7):485–90.
8 Harari D, Sarkarati M, Gurwitz JH, McGlinchey-Berroth G, Minaker KL. Constipation-related symptoms and bowel program concerning individuals with spinal cord injury. Spinal Cord 1997; 35(6):394–401.
9 Kirk PM, King RB, Temple R, Bourjaily J, Thomas P. Long-term follow-up of bowel management after spinal cord injury. SCI Nurs 1997;14(2):56–63.
10 Lynch AC, Wong C, Anthony A, Dobbs BR, Frizelle FA. Bowel dysfunction following spinal cord injury: a description of bowel function in a spinal cord-injured population and comparison with age and gender matched controls. Spinal Cord 2000;38(12): 717–23.
11 Stiens SA, Bergman SB, Goetz LL. Neurogenic bowel dysfunction after spinal cord injury: clinical evaluation and rehabilitative management. Arch Phys Med Rehabil 1997;78(3 Suppl): S86–102.
12 Stone JM, Nino-Murcia M, Wolfe VA, Perkash I. Chronic gastrointestinal problems in spinal cord injury patients: a prospective analysis. Am J Gastroenterol 1990;85(9):1114–9.
13 Menter R, Weitzenkamp D, Cooper D, Bingley J, Charlifue S, Whiteneck G. Bowel management outcomes in individuals with long-term spinal cord injuries. Spinal Cord 1997;35(9):608–12.
14 Harari D, Minaker KL. Megacolon in patients with chronic spinal cord injury. Spinal Cord 2000;38(6):331–9.
15 Krogh K, Mosdal C, Laurberg S. Gastrointestinal and segmental colonic transit times in patients with acute and chronic spinal cord lesions. Spinal Cord 2000;38(10):615–21.
16 Krogh K, Nielsen J, Djurhuus JC, Mosdal C, Sabroe S, Laurberg S. Colorectal function in patients with spinal cord lesions. Dis Colon Rectum 1997;40(10):1233–9.
17 Westgren N, Levi R. Quality of life and traumatic spinal cord injury. Arch Phys Med Rehabil 1998;79(11):1433–9.
18 Lynch AC, Antony A, Dobbs BR, Frizelle FA. Bowel dysfunction following spinal cord injury. Spinal Cord 2001;39(4):193–203.
19 Simpson LA, Eng JJ, Hsieh JT, Wolfe DL. The health and life priorities of individuals with spinal cord injury: a systematic review. J Neurotrauma 2012;29(8):1548–55.
20 Kirshblum SC, Burns SP, Biering-Sørensen F, Donovan W, Graves DE, Jha A, *et al.* International standards for neurological classification of spinal cord injury (revised 2011). J Spinal Cord Med 2011;34(6):535–46.
21 Ware JE, Jr., Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. Med Care 1992;30(6):473–83.
22 Bjorner JB, Damsgaard MT, Watt T, Groenvold M. Tests of data quality, scaling assumptions, and reliability of the Danish SF-36. J Clin Epidemiol 1998;51(11):1001–11.
23 Abrahamsson H, Antov S, Bosaeus I. Gastrointestinal and colonic segmental transit time evaluated by a single abdominal x-ray in healthy subjects and constipated patients. Scand J Gastroenterol Suppl 1988;152:72–80.
24 Leduc BE, Giasson M, Favreau-Ethier M, Lepage Y. Colonic transit time after spinal cord injury. J Spinal Cord Med 1997; 20(4):416–21.
25 Media S, Christensen P, Lauge I, Al-Hashimi M, Laurberg S, Krogh K. Reproducibility and validity of radiographically determined gastrointestinal and segmental colonic transit times in spinal cord-injured patients. Spinal Cord 2009;47(1):72–5.
26 Safadi BY, Rosito O, Nino-Murcia M, Wolfe VA, Perkash I. Which stoma works better for colonic dysmotility in the spinal cord injured patient? Am J Surg 2003;186(5):437–42.
27 Branagan G, Tromans A, Finnis D. Effect of stoma formation on bowel care and quality of life in patients with spinal cord injury. Spinal Cord 2003;41(12):680–3.
28 Coggrave MJ, Ingram RM, Gardner BP, Norton CS. The impact of stoma for bowel management after spinal cord injury. Spinal Cord 2012;50(11):848–52.
29 Kelly SR, Shashidharan M, Borwell B, Tromans AM, Finnis D, Grundy DJ. The role of intestinal stoma in patients with spinal cord injury. Spinal Cord 1999;37(3):211–4.
30 Munck J, Simoens C, Thill V, Smets D, Debergh N, Fievet F, *et al.* Intestinal stoma in patients with spinal cord injury: a retrospective study of 23 patients. Hepatogastroenterology 2008; 55(88):2125–9.
31 Rosito O, Nino-Murcia M, Wolfe VA, Kiratli BJ, Perkash I. The effects of colostomy on the quality of life in patients with spinal cord injury: a retrospective analysis. J Spinal Cord Med 2002; 25(3):174–83.
32 Stone JM, Wolfe VA, Nino-Murcia M, Perkash I. Colostomy as treatment for complications of spinal cord injury. Arch Phys Med Rehabil 1990;71(7):514–8.
33 Boakye M, Leigh BC, Skelly AC. Quality of life in persons with spinal cord injury: comparisons with other populations. J Neurosurg Spine 2012;17(1 Suppl):29–37.
34 Haran MJ, Lee BB, King MT, Marial O, Stockler MR. Health status rated with the medical outcomes study 36-item short-form health survey after spinal cord injury. Arch Phys Med Rehabil 2005;86(12):2290–5.

35 Hocevar B, Gray M. Intestinal diversion (colostomy or ileostomy) in patients with severe bowel dysfunction following spinal cord injury. J Wound Ostomy Continence Nurs 2008;35(2):159–66.
36 Randell N, Lynch AC, Anthony A, Dobbs BR, Roake JA, Frizelle FA. Does a colostomy alter quality of life in patients with spinal cord injury? A controlled study. Spinal Cord 2001;39(5): 279–82.
37 Luther SL, Nelson AL, Harrow JJ, Chen F, Goetz LL. A comparison of patient outcomes and quality of life in persons with neurogenic bowel: standard bowel care program vs colostomy. J Spinal Cord Med 2005;28(5):387–93.
38 Coggrave M, Wiesel PH, Norton C. Management of faecal incontinence and constipation in adults with central neurological diseases. Cochrane Database Syst Rev 2006;(2):pCD002115.
39 Pardee C, Bricker D, Rundquist J, MacRae C, Tebben C. Characteristics of neurogenic bowel in spinal cord injury and perceived quality of life. Rehabil Nurs 2012;37(3):128–35.
40 Coggrave M, Norton C, Cody JD. Management of faecal incontinence and constipation in adults with central neurological diseases. Cochrane Database Syst Rev 2014;1:pCD002115.
41 Anderson KD. Targeting recovery: priorities of the spinal cord-injured population. J Neurotrauma 2004;21(10):1371–83.