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RESEARCH

ASSESSMENT OF THE BOWEL DYSFUNCTIONS IN STROKE PATIENTS

ABSTRACT

Introduction: To asses bowel dysfunction in stroke patients, especially constipation and fecal incontinence, and to describe the factors that play a role in these conditions.

Materials and Methods: The study enrolled 112 patients with stroke. A detailed gastrointestinal symptom evaluation of the pre-and post-stroke period was performed, with special attention to constipation and fecal incontinence, The functional status of patients was evaluated using the Functional Independence Measurement, Brunstroom staging was used for the motor examination, and ambulation status was evaluated with the Functional Ambulation Scale.

Results: While only 29 patients had constipation prior to stroke, 83 patients were found to have post-stroke constipation. None of our patients complained of fecal incontinence in the pre-stroke period, although 23 patients developed fecal incontinence after stroke. We found that bowel dysfunctions such as constipation and fecal incontinence were not correlated with aphasia, thromboembolic or hemorrhagic stroke, side of stroke, medication, diabetes or gender. There were no significant relationships between the presence of constipation and patient age, Brunnstrom stage or functional ambulation scale score. Patients with low Brunnnstrom stage scores and functional ambulation scale scores, and also those over age 65, experienced more fecal incontinence.

Conclusions: Neurogenic bowel, which adversely affects the patient's quality of life, is a frequently encountered problem after stroke.

Key Words: Stroke; Constipation; Fecal Incontinence; Neurogenic Bowel.

ARAŞTIRMA

İNMELİ HASTALARDA BARSAK FONKSİYON BOZUKLUKLARININ DEĞERLENDİRİLMESİ

ÖZ

Giriş: İnmeli hastalarda konstipasyon ve fekal inkontinans başta olmak üzere bağırsak fonksiyon bozukluklarını değerlendirmeyi ve bunlara etki eden faktörleri ortaya koymayı amaçladık.

Gereç ve Yöntem: Çalışmaya 112 inmeli hasta alındı. Hastaların inme öncesi ve sonrasını içeren özellikle konstipasyon ve fekal inkontinans olmak üzere ayrıntılı gastrointestinal sistem sorgulaması yapıldı. Hastaların fonksiyonel durumları fonksiyonel bağımsızlık ölçümü ile, motor muayeneleri Brunstroom evrelemesi ile, ambulasyon durumları ise fonksiyonel ambulasyon skalası ile değerlendirildi.

Bulgular: İncelenen 112 hastanın inme öncesi 29'unda, inme sonrası ise 83'ünde konstipasyon vardı. İnme öncesi 112 hastanın hiçbirinde fekal inkontinans yokken, inme sonrası ise 23 hastada fekal inkontinansı bulundu. Hastalardaki konstipasyon ve fekal inkontinans gibi barsak disfonksiyonlarının afazi, tromboembolik veya hemorajik inme, sağ veya sol taraf inme, kullanılan ilaçlar, diyabet ve cinsiyet ile ilişkili olmadığı görüldü. Hastaların yaşı, Brunnstrom ve fonksiyonel ambulasyon skala evreleri ile konstipasyon varlığı arasında ilişki yoktu. Brunnstrom ve Fonksiyonel ambulasyon skala evresi düşük olan ayrıca 65 yaş üstü hastalarda daha fazla fekal inkontinansa rastlandı.

Sonuç: Sonuç olarak nörojenik barsak, inmeli hastalarda sık karşılaşılan, hastanın yaşam kalitesini olumsuz etkileyen, bir sorundur.

Anahtar Sözcükler: İnme; Konstipasyon; Fekal İnkontinans; Nörojenik Bağırsak.

Introduction

Neurogenic bowel dysfunction is a common complication of stroke and has adverse effects on rehabilitation, functional status and quality of life. In stroke patients, the most common symptoms associated with bowel dysfunction are constipation and fecal incontinence. The frequency of constipation has been reported to be 55% in the acute phase and 30-60% in the subacute and chronic phases. Fecal incontinence has also been reported to be 55% in the acute phase, falling to 11-22% in the subacute and chronic phases (1-6).

The etiology of bowel dysfunction in patients with stroke is multifactorial. Inactivity, depression, deficiencies in water and food intake, reduction in exercise capacity, drug usage, cognitive disorders, impaired consciousness and changes in the central and peripheral nervous systems all play an important role (1-5).

In this study we aimed to assess bowel dysfunction in stroke patients, especially constipation and fecal incontinence, and also to determine the factors that influence these conditions.

Material and Methods

One hundred and twelve stroke patients who applied to an inpatient rehabilitation program at our hospital and who met the inclusion criteria were enrolled in the study. Patients' demographic data, disease duration, and the type and side of the lesion were recorded. Other neurological problems associated with stroke (aphasia, cerebellar dysfunction), systemic disorders (hypothyroidism, hypertension, DM) and drugs used (beta blockers, ACE inhibitors, Ca channel blockers, antithrombocytes, anti-depressants) were noted.

Those with a history of gastrointestinal problems or diseases, abdominal and anorectal surgery, diseases that reduce colonic motility such as diabetes mellitus and hypothyroidism, the stroke duration of less than one month or longer than one year, bilateral hemiplegia, brain stem lesions, more than one attack, and additional neurological disorders were excluded from the study.

Patients were asked detailed questions about their gastrointestinal system (GIS) functioning before and after stroke. Topics included bowel emptying intervals and times, problems causing gastrointestinal symptoms (dysphagia, gastroesophageal reflux, nausea, vomiting, abdominal distention, abdominal pain, gastrointestinal bleeding, hemorrhoids and perianal problems such as rectal bleeding, and difficulty in passing stools), constipation and continence problems, drugs used for intestinal problems, and methods used to facilitate defecation. All patients were evaluated by ultrasound to investigate abdominal pathologies.

Constipation was defined as the presence of two or more of following Rome Criteria (7): Intestinal emptying less than 3 times per week, over-strain, considerable effort in at least 25% of bowel emptying, the presence of pellets in at least 25% of stools, the feeling of not purging completely in at least 25% of bowel emptying, the feeling of anorectal obstruction in at least 25% of bowel emptying, and at least 25% of bowel emptying requiring digital assistance. Fecal incontinence was defined as defecation at unwanted and unplanned times apart from bowel care (8).

The functional status of patients was assessed using the functional independence measure (FIM). Brunnstrom's stages of motor recovery was determined and ambulation status was evaluated using the functional ambulation scale (FAS). Patients were divided into two groups: nonfunctional ambulatory (FAS grade 0) and functional ambulatory (FAS stage 1, 2, 3 and 4).

Statistical analysis was performed using SPSS 13.0. For descriptive data, means ± standard deviations were calculated; categorical variables were shown as frequencies and percentages. Gastrointestinal problems in patients before and after stroke were compared using the Mc Nemar test. Student's t test was used to compare the elapsed time for toilet use before and after stroke and the range of bowel emptying times. Pearson's chi-square test was used to compare independent variables (patient age, FAS, the presence of urinary incontinence, duration of disease variables and the presence of constipation and fecal incontinence), while Spearman's correlation test for nonparametric data was used to evaluate the linear relationships among the other variables. Statistical significance for all tests was set at $p < 0.05$.

Results

The mean age of the 112 patients enrolled in the study was 62.5 ± 13.0 (22-87) years: 53 (47.3%) were men and 59 (52.7%) were women. Mean disease duration was 4.1 ± 2.8 (1-12) months. While 29 patients (25.9%) suffered a hemorrhagic cerebrovascular accident (CVA), 83 (74.1%) had had ischemic stroke. Forty-nine (43.8%) patients had right hemiplegia and 63 (56.2%) patients had left hemiplegia.

While the average median interval of pre-stroke intestinal emptying was 1.53±0.95 days, after stroke this increased to

Table 1— Intestinal Emptying ıntervals and Emptying Times Before and After Stroke.

	Before Stroke		After Stroke		
	n	%	n	%	p
Every day	72	64.3	26	23.2	< 0.01
Every other day	26	23.2	16	14.3	< 0.01
More than 3 days	13	11.6	56	50.0	< 0.01
Weekly	1	0.9	14	12.5	< 0.01

3.27±1.96 days. The average elapsed time for intestinal emptying was 5.72±3.47 minutes pre-stroke and 11.74±7.36 minutes after stroke. Intestinal emptying intervals and emptying time after stroke were significantly higher than pre-stroke values (p <0.01 for both); these variables are presented in Table 1. Results of the detailed questions about gastrointestinal system functioning showed a statistically significant rise in regurgitation, stomach pain, nausea, vomiting, abdominal pain, abdominal distension, rectal bleeding, and difficulty in emptying the stools after stroke, compared to pre-stroke (p<0.01). For gastrointestinal bleeding and hemorrhoids, there was no significant difference between pre-stroke and after stroke values (Table 2).

While 29 (25.9%) of 112 patients had constipation before stroke, 83 (74.1%) patients had constipation after stroke. None of the 112 patients had fecal incontinence before stroke, while fecal incontinence was found in 23 (20.5%) patients after stroke. The differences in constipation and fecal incontinence rates before and after stroke were found to be statistically significant (p<0.01).

No significant differences were found among age groups, type of lesion (hemorrhagic and ischemic), side of lesion, duration of disease and presence of constipation and fecal incontinence for the patients enrolled in our study (p>0.05). The frequency of fecal incontinence was significantly lower in patients under the age of 65 than in those over age 65 (p<0.05). Further, no significant relationships were found between the incidence of constipation and fecal incontinence and the use of medications taken by patients (p>0.05).

No significant relationships were found between constipation and Brunnstrom stages of the extremities (p> 0.05). While 77.5% of patients with FAS stage 0 had constipation, 72.2% of patients with FAS 1 and over had constipation. However, this difference was not statistically significant (p> 0.05). While there was no significant correlation between Brunnstrom hand scores and fecal incontinence (p>0.05), the relationships between upper and lower extremity Brunstrom phases and fecal incontinence were statistically significant (p<0.02 and p<0.01, respectively): the worse the lower extremity Brunnstrom phase, the higher the frequency of fecal incontinence.

The FIM total score was 64.8±22.0 in patients with constipation and 77.5±22.0 in patients without constipation. There were strong, significant negative correlations between the incidence of constipation and FIM self-care (r=-0.65), sphincter control (r=-0.51) and FIM total scores (r=-0.75) (p<0.05). There were no significant correlations between constipation and FIM mobility (r = 0.34), repositioning (r=0.28), communication and social sensing section scores (r=0.28) (p>0.05).

Although 47.5% of patients with FAS stage 0 had fecal incontinence, 52.5% did not; 5.5% of the 72 patients with

Table 2— Gastrointestinal System Problems Before and After Stroke.

	Before Stroke		After Stroke		
	n	%	n	%	p
Regurgitation	11	9.8	30	26.8	< 0.01
Stomach pain	22	19.6	37	33.0	< 0.01
Nausea- vomiting	2	1.8	20	17.9	< 0.01

FAS stage 1 and over had fecal incontinence and 94.5% did not. Fecal incontinence was observed significantly more frequently in the FAS Stage 0 group than in the FAS Stage 1 and over group ($p<0.05$).

The FIM total mean score was 43.5±16 for patients with fecal incontinence and 74.4±2. for patients without fecal incontinence. Strong, significant negative correlations were found between the incidence of incontinence and FIM self-care ($r=-0.75$, $p<0.00$), FIM sphincter control ($r=-0.9$, $p<0.00$), mobility ($r=-0.67$, $p<0.00$), displacement ($r=-0.52$, $p<0.00$), FIM communication ($p<0.04$), and FIM social recognition ($r=-0.43$, $p<0.01$) scores. Furthermore, there was a significant negative correlation between the incidence of fecal incontinence and FIM total scores ($r=-0.9$, $p<0.01$).

While 20 (17.9%) patients used defecation promoters or methods before stroke, 92 (82.1%) did not. We found that 89 (79.4%) patients used one or more medications and/or methods to promote defecation after stroke, while 23 (20.5%) patients used none; this difference was statistically significant ($p<0.01$).

Discussion

One unfavorable prognostic factor in the rehabilitation and functional status of patients with stroke is the presence of gastrointestinal problems. Dysphagia and bowel function disorders are the most frequently encountered gastrointestinal complaints after stroke (1,9,10).

Although there are extrinsic changes in the intestinal nervous system in neurological diseases that affect the central nervous system, the intrinsic nervous system remains functional and intact. Lesions affecting central control of defecation may involve both the sympathetic and parasympathetic components of defecation, reducing the coordination of peristaltic waves. In addition, the pelvic floor muscles and external sphincter may relax, leading to fecal incontinence (2). As in swallowing, cortical control of defecator function is localized in both hemispheres but is dominant in one hemisphere (11). Through topographic cortical mapping with transcranial magnetic stimulation, it has been shown that cortical control of defecation is located bilaterally in the motor cortex of the superior portion of both cerebral hemispheres (1,12). When the dominant center of defecation after stroke is damaged, its single clinical symptom may be constipation. Contralateral centers may be insufficient to maintain anorectal functions (1).

The etiology of bowel dysfunction in patients with stroke may be multifactorial. Inactivity, depression, deficiencies in water and food intake, reduction of exercise capacity, drug use, cognitive impairment, impaired consciousness and changes in the central and peripheral nervous systems play important roles (1-5).

In stroke patients, the most common symptoms associated with bowel dysfunction are constipation and fecal incontinence. While the rate of constipation in the acute phase is 55%, it has been reported as 30-60% in the subacute and chronic phase (1-6).

In the normal population, old age and female gender are predisposing factors for constipation. However, studies conducted with stroke patients have reported no significant relationships between constipation and age and gender (1,5,13). The absence of gender and age as factors in constipation for stroke patients supports the view that their bowel dysfunction is neurological in origin. The incidence of constipation does not differ significantly between thromboembolic and hemorrhagic infarct patients (2,5). Constipation has been found to be independent of specific brain lesion region and left or right hemisphere lesion, but is directly proportional to lesion size. This finding is related to the widespread involvement of different sites of brain damage (1). In our study, there was no correlation between the frequency of constipation and patients' age and gender, similar to previous studies. In addition, there was no relationship between the hemiplegic side and etiology of stroke and the presence of constipation. That the constipation occurs similarly in right and left hemiplegia supports the suggestion that the defecator center is located in both hemispheres.

In many studies, addiction and loss of physical activity have been shown to be largely responsible for constipation in stroke patients (2,5,14). In a study of 152 patients with hemiplegia, Robada found that Barthel Index scores of constipated patients were significantly low; they reported that there was less constipation among patients who were independent in activities of daily living (ADL) (5). Bracci compared 90 hemiplegic patients and 81 orthopedic patients who had similar mobility scores; they found a higher frequency of constipation in the hemiplegic group (1).In our study, 74.1% of stroke patients had constipation, and the presence of constipation was significantly higher than before the stroke. We found that the frequency of constipation was higher for patients whose FIM self-care, FIM sphincter control and FIM total scores were low. We did not find a significant relationship between constipation and FIM mobility, FIM relocation, FIM

communication, and FIM social perception scores. In addition, constipation was more frequent in our patients who had early-stage FAS but this finding was not statistically significant. There were no relationships between constipation and Brunnstrom stages in our patients. Results of our study not only associate constipation in hemiplegic patients to physical inactivity, but also support the suggestion that neurological mechanisms are involved in the development of constipation. As a result of damage to the central nervous system, control of the extrinsic nervous system of the intestine is affected; consequently, the regulation of bowel movements is disrupted and constipation is encountered clinically.

Drugs usage has been implicated as one factor affecting constipation in hemiplegic patients (1,2,5,15). Bracci detected highly significant correlations between constipation and the use of nitrates, glycosides and antithrombotics, while they did not find significant relationships between constipation and ACE inhibitors, Ca channel blockers, anticoagulants, anticonvulsants, and antidepressants (1). In our study, no statistically significant correlations were found between constipation and medications which are commonly used by patients. Significant drugs lead to constipation, whereas our patients has been using multiple drugs and this is why we couldn't detect the significant drugs' effect on constipation and got the insignificant result. Also Bracci said that the drugs inducing constipation could not be properly assessed since 35-70% of the patients received combination therapy (1).

Sixty eight percent of the patients included in our study had difficulty with defecation. To facilitate defecation, 56.3% of our patients used multiple treatments or methods. In our study, a high proportion of patients' drug usage may have been caused by not informing them about necessary diet changes earlier, and also by failing to explain that treatments are not for long-term use but to provide daily discharges. These results demonstrate that, in addition to disrupting the quality of life of stroke patients, constipation increases treatment costs and adds the burden of excessive use of drugs. In our study, we found a significant increase after stroke in gastrointestinal symptoms associated with bowel dysfunction, such as regurgitation, abdominal distension and pain, rectal bleeding after defecation, nausea, and vomiting. There was no increase in the presence of hemorrhoids, which we expected to accompany chronic constipation. The reason for insignificant result for presence of hemorrhoid could be because of being the patients' evaluation at a sectional period, while the anamnesis of the rectal bleeding was concerning whole period of the stroke.

While fecal incontinence in the acute phase was 55%, it has been reported to occur at the rate of 3-22% in subacute-chronic periods (1-6). Fecal incontinence after stroke is encountered at the rate of 31-40% within the first 2 weeks (4,16-18). A large proportion of early onset fecal incontinence after stroke may be temporary and usually seems to be related to impairment of consciousness, immobility, and poor patient care after neurological damage (1,19). Brittain showed that fecal incontinence in stroke survivors was 3.5 times higher than in control group(20). Fecal incontinence was 3-11% in the three months following stroke and in the next period (4,17). In their study, Brocklehurst reported that fecal incontinence was observed in 31% of 135 hemiplegic patients, most of whom had been seen in the first 2 weeks post-stroke (18). Fecal incontinence was observed in 14% of patients in the 8th week after stroke. In studies by Brittain and Nakayama, the fecal incontinence rate, initially around 40%, was reported to be 9% after 6 months (16,17). Quand reported that the fecal incontinence rate in their chronic stroke patients was 22% (21). In our study, 20.5% of 112 patients had fecal incontinence.

Nakayama found a higher rate fecal incontinence in women than men in the first week after stroke (17), while Quand found no differences between men and women on the same variable (21). In our study there was no significant correlation between the gender of patients and fecal incontinence. Nakayama found a significant relationship between age and fecal incontinence after stroke: for each 10-year increase in age they found that fecal incontinence increased 1.5 times (17). Our results were similar, in that fecal incontinence was found in only13.6% of patients under age 65, but this rose to 28.3% for patients over age 65.

Brocklehoust found that fecal incontinence was associated with being unable to turn in bed, get out of bed, or stand (18). Nakayama reported that patients with fecal incontinence had low Barthel Index (17). In our study, similar to those reviewed above, stages of the FAS were lower in patients with fecal incontinence; this included functional independence scores in all sections, as well as total scores. In addition, upper and lower extremities Brunnstrom stages of patients with fecal incontinence were lower. Unlike the data for constipation, these results show that fecal incontinence depends on factors that may be modified, and which develop secondary to hemiplegia such as loss of mobility, functional disability, inadequacy of transfers, toilet access difficulties, cognitive impairment, communication difficulties and poor maintenance, in addition to neurological damage.

Brocklehoust found that left hemiplegia is more associated with fecal incontinence than is right hemiplegia (18). However, Bracci could not detect a difference between right, left or different brain lesion localizations and the frequency of fecal incontinence (1). While Nakayama did not find a relationship between the hemiplegic sides, they did find that lesions that were hemorrhagic, large and involved the cerebral cortex constituted risk factors. In our study we did not find a relationship between fecal incontinence and hemiplegic side (17).

After stroke, neurogenic bowel and related problems are common (22). In our study, the frequency of constipation and fecal incontinence increased, and both intestinal discharge times and the discharge interval were extended. Moreover, significant correlations were found between the various parts of FIM and constipation and the frequency of fecal incontinence. In the presence of a neurogenic bowel condition, constipation is an important and frequent gastrointestinal problem. Initially, it is not perceived as a major problem by patients and their relatives. Further, it makes patient care easy because it decreases the frequency of fecal incontinence. However, as duration of the disease progresses, it causes an increase in the duration of intestinal emptying and an extension of emptying intervals. This situation increases the problem of constipation and leads to a vicious cycle. Moreover, the incidence of gastrointestinal symptoms such as abdominal pain, abdominal distension, and rectal bleeding increases along with constipation. This condition leads to the use of more medication and methods to facilitate discharging the intestine after stroke. In addition, the increase in the frequency of fecal incontinence may cause significant restrictions on the social life of patients and their caregivers. An increase in the time required for bowel care and resulting symptoms poses a significant problem for patients and their relatives, and is considered a high-priority issue.

In general, neurogenic bowel and the consequent constipation and fecal incontinence are problems in subacute and chronic stroke patients that causes difficulties in rehabilitation programs, where it needs to be addressed.

The major limitations of this study are being a cross-sectional study, periodic comparisons not to be made and a large period of stroke patients to be included the study.

References

1. Bracci F, Badiali D, Pezzotti P, et al. Chronic constipation in hemiplegic patients. World J Gastroenterol 2007;13(29):3967-72. (PMID:17663511).
2. Winge K, Rasmussen D, Werdelin LM. Constipation in neurological diseases. J Neurol Neurosurg Psychiatry 2003;74(1):13-9. (PMID:12486259).
3. Duncan PW, Zorowitz R, Bates B, et al. Management of Adult Stroke Rehabilitation Care: A clinical practice guideline. Stroke 2005;36(9):100-43. (PMID:16120836).
4. Harari D, Coshall C, Rudd AG, Wolfe CD. New-onset fecal incontinence after stroke: prevalence, natural history, risk factors, and impact. Stroke 2003;34(1):144-50. (PMID:12511766).
5. Robain G, Chennevelle JM, Petit F, Piera JB. Incidence of constipation after recent vascular hemiplegia: A prospective cohort of 152 patients. Rev Neurol 2002;158(5):589-92. (PMID:12072827).
6. Su Y, Zhang X, Zeng J, et al. New onset constipation at acute stage after first stroke: Incidence, risk factors, and impact on the stroke outcome. Stroke 2009;40(4):1304-09. (PMID:19228840).
7. Garrigues V, Gálvez C, Ortiz V, et al. Prevalence of constipation: agreement among several criteria and evaluation of the diagnostic accuracy of qualifying symptoms and self-reported definition in a population-based survey in Spain. Am J Epidemiol 2004;159(5):520-6. (PMID:14977649).
8. Inanır M. Neurogenic Bowel Dysfunction. In: Oğuz H, Dursun E, Dursun N (Eds). Tıbbi Rehabilitasyon. 2nd edition, Nobel Tıp, İstanbul, Turkey, 2004, pp 765-77.
9. Yi JH, Chun MH, Kim BR, et al. Bowel function in acute stroke patients. Ann Rehabil Med 2011;35(3):337-43. (PMID:22506142).
10. Belsey J, Greenfield S, CandyD, Geraint M. Systemic review: Impact of constipation on quality of life in adults and children. Aliment Pharmacol Ther 2010;31:938-49. (PMID:20180788).
11. Martin RE, Sessle BJ. The role of the cerebral cortex in swallowing. Review. Dysphagia 1993;8(3):195-202. (PMID:8359039).
12. Lawrence CB, Turnbull AV, Rothwell NJ. Hypothalamic control of feeding. Curr Opin Neurobiol 1999;9(6):778-83. (PMID:10607641).
13. Harari D, Gurwitz JH, Avorn J, et al. Correlates of regular laxative use by frail elderly persons. Am J Med 1995;99(5):513-8. (PMID:7485209).
14. Staiano A, Giudice E. Colonic transit and anorectal manometry in children with severe brain damage. Pediatrics 1994;94:169-73. (PMID:8036068).
15. Harari D, Norton C, Lockwood L, Swift C. Treatment of constipation and fecal incontinence in stroke patients: Randomized controlled trial. Stroke 2004;35(11):2549-55. (PMID:15486330).
16. Brittain KR, Peet SM, Castleden CM. Stroke and incontinence, review. Stroke 1998;29(2):524-8. (PMID:9472900).
17. Nakayama H, Jørgensen HS, Pedersen PM, et al. Prevalence and risk factors of incontinence after stroke: The Copenhagen Stroke Study. Stroke 1997;28:58-62. (PMID:8996489).
18. Brocklehurst JC, Andrews K, Richards B, Laycock PJ. Incidence and correlates of incontinence in stroke patients. J Am Geriatr Soc 1985;3(8):540-2. (PMID:4019999).

19. Nazarko L. Rehabilitation and continence promotion following a stroke, review. Nurs Times 2003;99(44):52-5. (PMID:14649144).
20. Brittain K, Perry S, Shaw C, et al. Isolated urinary, fecal, and double incontinence: Prevalence and degree of soiling in stroke survivors. J Am Geriatr Soc 2006;54(12):1915-9. (PMID:17198499).
21. Quander CR, Morris MC, Melson J, et al. Prevalence and factors associated with fecal incontinence in a large community study of older individuals. Am J Gastroenterol 2005;100(4):905-9. (PMID:15784039).
22. Nelson RL. Epidemiology of fecal incontinence. Gastroenterology 2004;126:3-7. (PMID:14978632).