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ORIGINAL ARTICLE

Effect of need to void on Parkinsonian gait

Effet du besoin d'uriner sur la marche Parkinsonienne

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KEYWORDS
Parkinsonian disorders;
Gait disorders;
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Summary
Aims. — Beside motor control alteration and tremor, the main symptoms in Parkinsonian disorders, lower urinary tract dysfunction is very common and thus often associated with gait disorder. No studies have assessed their association yet. The aim of this study was to assess the effect of the need to void on walking speed in this particular population. The secondary aim was to assess the effect of desire to void in a double task condition on the walking speed, and on the time to raise up from the floor.
Methods. — This prospective study included all Parkinsonian disorders who had a follow-up for overactive bladder (OAB). We invited them to drink until a desire to void or equivalent (DV), then they performed three ten-meters walk tests, one double-task ten-meters walk test, one timed-up-and-go test (TUG), one timed raise of the floor (GMT). We repeated the same tests just after bladder emptying.
Results. — Nine men and two women (age 69 ± 6) were included in the study (seven Parkinson's Diseases, two multisystem atrophies, two not yet characterized). Mean scores of UPDRS-III were 17 ± 6.5, Hoehn & Yahr scale were 1.9 ± 0.7, time since onset 7 ± 4.4 years, levodopa daily equivalent 691 ± 478 mg. Patients performed the walking tests at DV with a mean bladder volume from 220 ± 189 mL. The mean speed was 1 m/s at DV and 1.1 m/s at PV ($P < 0.001$). TUG was also increased for patients at DV: mean 9.8 s at DV versus 8.8 sec at PV ($P < 0.003$).

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Conclusion. — In Parkinsonian disorders, need to void may impact the walking speed, a strong desire to void worsening gait velocity.
Level of evidence.— 4.

MOTS CLÉS
Maladie de Parkinson ;
Troubles de la marche ;
Troubles du bas appareil urinaire

Résumé
Introduction. — Outre les altérations motrices et le tremblement des syndromes parkinsoniens, les troubles du bas appareil urinaire sont fréquents et associés aux troubles de la marche. Aucune étude n'a évalué leur association. L'objectif principal de cette étude était d'évaluer l'effet du besoin d'uriner sur la vitesse de marche dans les syndromes parkinsoniens. Les objectifs secondaires étaient d'évaluer l'effet du besoin d'uriner sur la vitesse de marche en double tâche, le temps de relever du sol (GMT), le timed-up-and-go (TUG).
Méthodes. — Cette étude prospective incluait tous les patients avec un syndrome parkinsonien suivis pour une hyperactivité vésicale. Ils devaient boire jusqu'à un besoin fort d'uriner et réalisaient trois tests de marche de dix mètres, un test de marche de dix mètres en double tâche, un TUG, un GMT. On répétait les mêmes mesures après vidange vésicale.
Résultats. — Neufs hommes et deux femmes (age 69 ± 6) ont été inclus, soit sept maladies de Parkinson idiopathiques, deux atrophies multi-systématisées, deux syndromes parkinsoniens non étiquetés. Pour cette population, le score moyen UPDRS-III était à 17($\pm$6.5) et l'échelle Hoehn & Yahr à 1.9 ($\pm$0.7). Le temps d'évolution de la maladie depuis le début des symptômes était de 7 ans ($\pm$4.4). Les patients ont réalisé les tests de marche avec un besoin fort d'uriner pour un volume moyen de 220 ± 189 mL. La vitesse de marche était significativement augmentée après vidange vésicale comparée à celle enregistre lors d'un besoin fort d'uriner (1,1 m/s contre 1 m/s $P < 0{,}001$). Le TUG était significativement plus court après vidange vésicale comparé à un besoin fort d'uriner (8,8 s contre 9,8 s $p < 0{,}003$).
Conclusion. — Dans les syndromes parkinsoniens modérés, le besoin d'uriner peut impacter les performances de marche.
Niveau de preuve.— 4.

Introduction

Parkinsonian syndromes are commonly integrated in degenerative diseases with a prevalence for Parkinson's disease (PD) around 0.31% [1]. Bradykinesia, rigidity or tremor can occur and impact several functions. These symptoms lead to gait disorders — hypokinetic rigid gait, with or without freezing of gait [2], postural (camptocormia, flexor muscles hypertonia) and balance abnormalities. Gait disorders are a primary concern since they can lead to a higher risk of falls [3]. Beside these motor symptoms, autonomic dysfunction with lower urinary tract symptoms (LUTS) is frequently with an estimated incidence rate of 27—80% [4]. The most common urinary symptom is overactive bladder (OAB) — characterized by urgency, frequency, urgency urinary incontinence and nocturia [4] — which increase during the course of the diseases [5], leading to a severe impact on the quality of life of these patients [6].

In normal subjects, the effect of bladder filling and subsequently the desire to void on gait velocity was described [7], questioning about the relationship between micturition and gait pathways and control centers connexions. It has been postulated that bladder filling influences walking activity because of the close anatomical location and physiological contiguity of encephalic and medullar control of these two functions. No studies have yet assessed this specific relationship in Parkinson disease. However this relationship can be interesting to evaluate since desire to void may be troublesome, making the patient hurry to the washroom, and thus leading to a high risk of falls in patients already subject to such risk due to motor dysfunction [8].

The aim of the study was to assess the effect of the need to void on the walking speed in patients with Parkinsonian disorders and LUTS. The secondary aim of the study was to assess the effect of strong desire to void in a double task condition on the walking speed, and the effect on the time to rise up from the floor.

Methods

Patients

This prospective monocentric study was conducted in patients with Parkinsonian disorders consulting in

Neuro-urology department of a University Hospital for LUTS between October and December 2017. Inclusion criteria were: adults with parkinsonian disorders (Parkinson's disease, Multisystem Atrophy, Vascular Parkinsonism, Dementia with Lewy Bodies, Progressive Supranuclear Palsy, Corticobasal Degeneration), OAB, Hoehn and Yahr stage between I and III, and to be able to perform walking tests (walk perimeter over 50 m, warning time over 5 min).

Exclusion criteria were: severe cognitive disorders (MoCA < 20/30), urinary tract infection, instable psychiatric disorders, and other neurologic disease especially on an acute phase.

This study was approved by the local ethics committees. All subjects gave an express consent.

Measure and procedure

Clinical examination was performed while the patients were invited to drink water until they experiment a strong desire to void. Medical history, treatment were collected. Urinary symptoms were assessed by the urinary symptom profile (USP) [9] and the International Prostate Symptom Score (IPSS) [10], motor part was assessed by MDS-UPDRS-III [11]. We estimated the bladder volume with sonography at the moment of the strong desire to void. Then, patients performed three times a 10-meters walking test (departing and arriving standing) with an oral start signal (3, 2, and 1, go). These tests were all performed at a strong desire to void (DV) and then after voiding or post-catheterization (PV); in this order so it was quicker and more convenient for the patient. One 10-meters walking test on a double task condition (subtract 7 from 100), one timed-up-and-go test (TUG) and a global mobility task (GMT: to raise from the floor with a cut-off at 60 s) were performed.

Statistical analysis

Statistical analysis were performed with the R software (Rx64 3.2.3 R Development Core Team, http://www.R-project.org).

We used signed rank Wilcoxon test to compare the DV and PV condition for the 10-meters walking speed on the normal and double-task conditions, the time to perform the timed-up-and-go test, the time to raise up from the floor.

We used standard deviations and coefficients of variation to assess the variability of walking speed on the DV and on the PV conditions.

Results

Population

Nine men and two women (mean age 68.9 ± 6) with Parkinson's disorders (seven Parkinson's Diseases, two multisystem atrophies, two Parkinsonian syndromes not yet characterized) were included in the study. Mean scores of MDS-UPDRS-III were 17.3 ± 6.5; Hoehn & Yahr scale were 1.9 ± 0.7; time since onset were 7.1 ± 4.4 years. Levodopa daily equivalent was 691.8 ± 478.7 mg: 8 patients took dopaminergic agonists and 9 took levodopa. For the LUTS treatment, 3 patients used intermittent catheterization, 3 took parasympathycolytics, 2 took alpha blockers and 1 patient used TENS. The patients performed the walking tests at DV at a mean estimated bladder volume of 220.1 ± 189.4 mL.

Table 1 Population description: initial characteristics and urodynamic analysis in 11 patients with Parkinsonian disorders.

Age (mean, SD)	68.9 (6)
Sex: Men (*n*)	9
Parkinson Disorders (*n*)	11
PD	7 (63.6%)
MSA	2 (18.2%)
Other	2 (18.2%)
MDS-UPDRS-III (mean, SD)	17.3 (6.5)
Hoehn & Yahr (mean, SD)	1.9 (0.7)
Years since onset (mean, SD)	7.1 (4.4)
Comorbidities (*n*)	
DBS	1 (9.1%)
BPH	4 (36.4%)
Bladder emptying	
ISC (*n*)	3 (27.3%)
Warning time (minutes, median, Q1—Q3)	5 (5—120)
IPSS (mean, SD)	13 (6.6)
USP (mean, SD)	11.8 (4.3)
Stress incontinence	0.82 (1.40)
OAB	7.7 (4.7)
Voiding	3.27 (3.47)
Volume at desire to void (mL) (mean, SD)	220,1 (189,4)
DO (*n*)	9 (81.8%)
PD	6 (54.5%)
MSA	1 (9.1%)
Other	2 (18.2%)
Underactivity (*n*)	3 (27.3%)
PD	1 (9.1%)
MSA	2 (18.2%)
Other	0
Sphincter deficiency (*n*)	1 (9.1%)
PD	1 (9.1%)
MSA	0
Other	0

SD: standard deviations; PD: Parkinson's Disease; MSA: multisystem atrophy; DBS: deep Brain stimulation; BPH: benign prostate hyperplasia; ISC: intermittent self-catheterization; IPSS: International Prostate Symptom Score; USP: urinary symptom profile; OAB: overactive bladder; DO: detrusor over activity.

Urodynamic results demonstrated detrusor overactivity in 6/7 PDs, 1/2 MSA and 2/2 other extrapyramidal syndromes. Urinary retention, defined as a post-void residual more than 150 mL, was observed in 2/7 PDs and 2/2 MSA, voiding dysfunction in 3/7 PDs and 1/2 MSA, underactive bladder in 2/2 MSA and 1/7 PD, and sphincter deficiency in 1/7 PD patient. Compliance were normal.

These results are summarized in the Table 1.

Walking tests

For the 10-meters tests, mean speed at DV was 1.01±0.24 (mean ± SD) m/sec and PV 1.10 (0.29) m/s, which is a

significant positive difference of 0.09 m/s ($P < 0.001$). Cadences and stride lengths increased significantly as well on the PV condition (respectively 1.86 ± 0.24 $P = 0.004$; 0.60 ± 0.12 $P < 0.001$) in comparison with the DV condition (respectively 1.75 ± 0.30 $P = 0.004$; 0.57 ± 0.12 $P < 0.001$).

Patients took significantly less time (−1 second mean) to perform TUG after voiding ($P = 0.003$).

For the double-task 10-meters test, no significant differences were observed for mean speed; as well as to raise from the ground.

All the results are summarized in Table 2.

Discussion

Voiding and Walking

This study assumes that a desire to void alters walking performances in Parkinson's Disease and related disorders.

Gait disturbance is a constant concern in PD. This alteration lead to lower quality of life, less independence, and an increased mortality risk [2] as well as the urinary symptoms, which combined together, worsen their consequences on the daily life.

Analyzing the gait speed in the 10 meters walking test [10], the small difference between gait speed before and after voiding when strong desire to void occurs, was under 0.1 m/s, which can be considered as a poor clinical relevance [11]. However, this result is probably underestimated. Primarily because we performed a 10-meters walking test which is a small distance. These results could be sensitized with a longer walking test (20 m, 2 min walking tests) regarding on patients warning times. Another explanation is the motor fatigability, which can occur. Indeed, after all these tests and as the PV condition was assessed after the DV condition, so this may minimize the difference between walking speed analysis sessions. Furthermore, we didn't realize post voiding bladder estimation. Besides spontaneous diuresis which immediately fill the bladder, few patients had incomplete urinary retention, with so a not complete bladder emptying during the second test.

Concerning the TUG, it is also a reliable and interesting measure in these patients [12] where an increased TUG time significantly associates with increased fall risk [13]. Indeed, it's a more complex task with an approach to an obstacle, and then they have to turn. In this Parkinsonian population, in which the risk of fall is high, turning is known to be tougher, leading to festination and or freezing of gait. The patient after voiding took significantly 1 s mean time to perform TUG, which could show a higher risk of fall.

Limitations

The principal limitation of the present study is the small population without sample size calculation, so we couldn't perform any significant correlations or subgroup analysis specially to distinguish subjects and effects between MSA, PD or other extrapyramidal syndromes. The population is heterogeneous and reflects a specific population who consults for LUTS in a specialized center, so probably more symptomatic and resistant to first line treatment.

Even the ten meter walk test have a good reliability [10], clinical tests are less precise than instrumental assessment, and some gait parameters such as swing time, and duration of single support could not be studied.

One another limitation is the time from treatment, since it is well known that some drugs as levodopa have a direct impact on the bladder [4]. Indeed, need to void can occur at any time of everyday life, depending on oral intake and independently from drugs intake. In this study, we didn't perform a pure evaluation of extrapyramidal function (ON state). We know that there is variability of motor symptoms with ON/OFF periods in moderate to severe patients, and of urinary function especially with the importance of hydration, other drugs intake (diuretics, anti-cholinergics) which only resume these results to this particular DV condition.

Physiological analyzes

Several mechanisms can be discussed.

Other studies focused on the relation between bladder filling — and gait in continent women [7] — or balance in a stress urinary incontinent population [14] assuming that there is a common pathway between gait and urinary control centers.

Some authors report that bladder filling activates some motoneuronal inhibitory descending spinal pathways [17] infering with gait and urinary control descending pathways adding a more consistent physiological proof of worsening of gait speed in a need to void condition.

Even in a volunteer continent women population of 51 years mean [7], authors demonstrated a significant difference in mean gait speed from a strong desire to void condition (1.32 ± 0.19 m/s) in comparison with a post voiding condition (1.37 ± 0.18 m/s; $P = 0.006$).

The sequence of the test can have a negative influence on performance, by the fatigue induced by the previous tests and by the fatigue induced by bladder emptying, like undressing, sitting, etc. These difficulties were not timed or assessed.

Effects of basal ganglia on micturition is thought to be inhibitory, then loss of striatal dopamine seems to activate the dopamine D1-Gabaergic direct pathway which inhibits the basal ganglia output [16,17] which may reflect the pure OFF state of these patients.

Clinical implications

LUTS in extrapyramidal syndromes are very variable with hydration variability, levodopa intake hours. To analyze these effects at different time from levodopa intake or in normalized time could be interesting for a better understanding. Even if we know there are some links between urinary function and walking speed in a healthy population, the difference tends to be more important in our extrapyramidal population. These changes in this neurogenic population must be taken in account since the importance of functional impact. Indeed, because of gait disorders, patients could not go as easily to the toilet emptying their bladder and thus modify gait performance. Moreover, quality of life is strongly affected by urinary symptoms in this parkinsonian population [20] specially decreased

Table 2 Comparison of the walking speed, the walking speed in a double task condition and the time to raise up from the floor with or without need to void in 11 patients with Parkinsonian disorders.

Clinical Tests		DV	PV	Signed Wilcoxon *P* values
		Value average (SD)		
10 m walking test	Velocity (m/s)	1.01 (0.24)	1.10 (0.29)	$p < 0.001$
	Cadence (steps/s)	1.75 (0.30)	1.86 (0.24)	$p = 0.004$
	Stride length (meters)	0.57 (0.12)	0.60 (0.12)	$p < 0.001$
Double task 10 m	Velocity (m/s)	−23.76	−19.93	$p = 0.965$
% Differences	Cadence (steps/s)	−12	−12.94	$p = 0.476$
	Stride length (meters)	−10.53	−7.3	$p = 0.366$
TUG	Time (sec)	9.79 (2.43)	8,79 (1.84)	$p = 0.003$
GMT	Time (sec)	11.16 (9.55)	13.62 (22.69)	$p = 0.105$

TUG: Timed Up and go Test; GMT: Global Mobility Test; DV: desire to void; PV: post voiding; SD: standard deviations.

bladder capacity and detrusor overactivity [21] strengthening the interest to assess and treat LUTS.

Conclusion

Desire to void may alter gait speed and increase risk of falls in Parkinsonian patients. Specific management of LUTS especially OAB symptoms, could probably help the control of gait alteration in this particular population. Other larger studies could enhance these hypotheses and add quality of life assessment, qualitative gait analysis with video take.

Disclosure of interest

The authors declare that they have no competing interest.

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