

## 科学研究費助成事業（科学研究費補助金）研究成果報告書

平成25年6月7日現在

機関番号：32661

研究種目：挑戦的萌芽研究

研究期間：2010～2012

課題番号：22659291

研究課題名（和文）近赤外線分光法 fNIRS による排尿に応じた脳活動測定

研究課題名（英文）Brain activation measurement by NIRS in response to bladder behavior

研究代表者

榊原 隆次 (SAKAKIBARA RYUJI)

東邦大学・医学部・准教授

研究者番号：00282476

研究成果の概要（和文）：

我々は、座位ウロダイナミクスでの、自然に近い連続蓄尿排尿に呼応した脳活動を、機能的近赤外線分光法(functional near-infrared spectroscopy, fNIRS)を用いて検討した。対象は、排尿筋過活動(DO)を有さない対照群 5 名(男性 1 名女性 4 名; 平均年齢 61 歳[38-70])と、DO を有する群 4 名(全例男性; 平均年齢 55 歳[33-65])である。前頭葉外側面を関心領域とした酸化ヘモグロビン濃度(oxy-Hb)リアルタイム測定を、座位・閉眼・流水音(ホワイトノイズ)下ウロダイナミクス時に 2 度行った。初発尿意および最大尿意時に、右手を軽く挙上するよう指示した。その結果、対照群: 1)oxy-Hb は初発尿意より前から緩徐に増加, 2)oxy-Hb は蓄尿中緩徐に増加し排尿直後がピーク, 3)oxy-Hb は排尿中緩徐に低下, 4)排尿不可の者も、排尿企図後 oxy-Hb は緩徐に低下, 5)賦活部位は両側前頭前野、特に Brodmann 8,10,46 野で顕著であった。DO 群: 6)初発尿意前の oxy-Hb 増加が稀で、前頭前野賦活が弱い傾向がみられたが、その他は対照群と同様であった。すなわち、fNIRS を用いて、座位ウロダイナミクス時、自然に近い連続蓄尿排尿に呼応した前頭前野賦活を確認できた。さらに、抗コリン薬の投与前後で同様の検討を行ったところ、過活動膀胱(OAB)で低下していた前頭前野賦活が正常化する傾向を認めた。

研究成果の概要（英文）： Aim of this study is to explore brain activity in the frontal micturition area during natural bladder behaviour. Five control subjects (one man and four women; mean age 61 years [38-70]) and four subjects with detrusor overactivity (all men; mean age 55 years [33-65]) were enrolled in the study. We performed real-time measurements of oxyhemoglobin concentration (oxy-Hb) changes in the frontal micturition area using functional near-infrared spectroscopy (fNIRS) in response to quasi-natural, continuous bladder filling and voiding in a sitting position. In the control group the following results were obtained: 1) a slight increase of oxy-Hb before first sensation occurred, 2) there was a continuous increase of oxy-Hb during bladder filling to the point just after voiding began, 3) there was a continuous decrease of oxy-Hb after voiding, 4) in subjects who were unable to urinate, oxy-Hb also decreased after attempting to void, and 5) the area activated was the bilateral lateral prefrontal area, particularly Brodmann's areas 8, 10 and 46. In the detrusor overactivity group, 6) an increase of oxy-Hb before first sensation was rare and frontal cortical activation was weak, 7) at the moment detrusor overactivity appeared, fNIRS brain activity in the frontal cortex did not change significantly; and otherwise the results were almost the same as those in the control group. This study shows that the frontal micturition area is activated during natural bladder filling and voiding using fNIRS. We were also able to show normalization of decreased prefrontal activity after administration of anticholinergics.

交付決定額

(金額単位：円)

	直接経費	間接経費	合計
2010年度	200,000	60,000	260,000
2011年度	100,000	30,000	130,000
2012年度	100,000	30,000	130,000
年度			
年度			
総計	400,000	120,000	520,000

研究分野：医歯薬学

科研費の分科・細目：外科系臨床医学・泌尿器科学

キーワード：排尿学

1. 研究開始当初の背景

排尿に呼応した動的脳活動は従来報告されていない。

2. 研究の目的

我々は、座位ウロダイナミクスでの、自然に近い連続蓄尿排尿に呼応した脳活動を、機能的近赤外線分光法(functional near-infrared spectroscopy, fNIRS)を用いて検討した。

3. 研究の方法

対象は、排尿筋過活動(DO)を有さない対照群5名(男性1名女性4名;平均年齢61歳[38-70])と、DOを有する群4名(全例男性;平均年齢55歳[33-65])である。前頭葉外側面を関心領域とした酸化ヘモグロビン濃度(oxy-Hb)リアルタイム測定を、座位・閉眼・流水音(ホワイトノイズ)下ウロダイナミクス時に2度行った。初発尿意および最大尿意時に、右手を軽く挙上するよう指示した。

4. 研究成果

対照群:

- 1)oxy-Hb は初発尿意より前から緩徐に増加,
- 2)oxy-Hb は蓄尿中緩徐に増加し排尿直後がピーク,
- 3)oxy-Hb は排尿中緩徐に低下,
- 4)排尿不可の者も、排尿企図後 oxy-Hb は緩徐に低下,
- 5)賦活部位は両側前頭前野、特に Brodmann 8,10,46野で顕著であった。

DO 群:

6)初発尿意前の oxy-Hb 増加が稀で、前頭前野賦活が弱い傾向がみられたが、その他は対照群と同様であった。すなわち、fNIRS を用いて、座位ウロダイナミクス時、自然に近い連続蓄

尿排尿に呼応した前頭前野賦活を確認できた。さらに、抗コリン薬の投与前後で同様の検討を行ったところ、過活動膀胱(OAB)で低下していた前頭前野賦活が正常化する傾向を認めた。

5. 主な発表論文等

(研究代表者、研究分担者及び連携研究者には下線)

[雑誌論文] (計 45 件)

1. 土井啓員, 榊原隆次, 平井成和, 真坂互, 岸雅彦, 小川恵美奈, 館野冬樹, 石井敏浩, 小暮麻由美, 佐藤光利. パーキンソン病患者の上部消化管運動機能評価における<sup>13</sup>C呼気検査の応用. 安定同位体と生体ガス 査読有 2011/12 3(1):13-17
2. Tateno F, Sakakibara R, Kishi M, Ogawa E, Yoshimatsu Y, Takada N, Suzuki Y, Mouri T, Uchiyama T, Yamamoto T. Incidence of emergency intestinal pseudo-obstruction in Parkinson's disease. J Am Geriatr Soc. 査読有 2011 Dec;59(12):2373-5.
3. Tateno F, Sakakibara R, Kishi M, Ogawa E, Yoshimatsu Y, Takada N, Suzuki Y, Mouri T, Uchiyama T, Yamamoto T. Incidence of emergency intestinal pseudo-obstruction in Parkinson's disease. J Am Geriatr Soc. 査読有 2011 Dec;59(12):2373-5.
4. Sakakibara R, Uchida Y, Ishii K, Kazui H, Hashimoto M, Ishikawa M, Yuasa T, Kishi M, Ogawa E, Tateno F, Uchiyama T, Yamamoto T, Yamanishi T, Terada H; the members of SINPHONI (Study of Idiopathic Normal Pressure Hydrocephalus On Neurological Improvement). Correlation of right frontal hypoperfusion and urinary dysfunction in iNPH: A SPECT study. Neurourol Urodyn. 査読有 2011 Oct 28. doi: 10.1002/nau.21222. [Epub ahead of print]

5. Tateno F, [Sakakibara R](#), Kawai T, Kishi M, Murano T. Alpha-synuclein in the Cerebrospinal Fluid Differentiates Synucleinopathies (Parkinson Disease, Dementia With Lewy Bodies, Multiple System Atrophy) From Alzheimer Disease. *Alzheimer Dis Assoc Disord*. 査読有 2011 Oct 26. [Epub ahead of print]
6. [Sakakibara R](#), Tateno F, Kishi M, Tsuyuzaki Y, Uchiyama T, Yamamoto T. Pathophysiology of bladder dysfunction in Parkinson's disease. *Neurobiol Dis*. 査読有 2011 Oct 10. [Epub ahead of print]
7. [Sakakibara R](#), Kishi M, Ogawa E, Tateno F, Uchiyama T, Yamamoto T, Yamanishi T. Bladder, bowel, and sexual dysfunction in Parkinson's disease. *Parkinsons Dis*. 査読有 2011;2011:924605. Epub 2011 Sep 12.
8. Suzuki J, [Sakakibara R](#), Tomaru T, Tateno F, Kishi M, Ogawa E, Kurosu T, Shirai K. Stroke and Cardio-ankle Vascular Stiffness Index. *J Stroke Cerebrovasc Dis*. 査読有 2011 Aug 19. [Epub ahead of print]
9. Hosoe N, [Sakakibara R](#), Yoshida M, Wakabayashi T, Kikuchi H, Yamada T, Kawahara K, Kishi M. Acute, severe constipation in a 58-year-old Japanese patient. *Gut*. 査読有 2011 Aug;60(8):1059, 1093.
10. Ishii K, Hashimoto M, Hayashida K, Hashikawa K, Chang CC, Nakagawara J, Nakayama T, Mori S, [Sakakibara R](#). A Multicenter Brain Perfusion SPECT Study Evaluating Idiopathic Normal-Pressure Hydrocephalus on Neurological Improvement. *Dement Geriatr Cogn Disord*. 査読有 2011;32(1):1-10. Epub 2011 Jul 29.
11. Kishi M, [Sakakibara R](#), Ogawa E, Tateno F, Takahashi O, Koga M. Bilateral abducens palsy in a case of cytomegalovirus-associated Guillain-Barré syndrome. *Neurol Sci*. 査読有 2011 Jul 22. [Epub ahead of print]
12. Tateno F, [Sakakibara R](#), Kishi M, Ogawa E, Hashimoto's Ophthalmopathy. *Am J Med Sci*. 査読有 2011 Jul;342(1):83-5.
13. Tateno F, [Sakakibara R](#), Yokoi Y, Kishi M, Ogawa E, Uchiyama T, Yamamoto T, Yamanishi T, Takahashi O. Levodopa ameliorated anorectal constipation in de novo Parkinson's disease: The QL-GAT study. *Parkinsonism Relat Disord*. 査読有 2011 Jun 24. [Epub ahead of print] PMID:21705259 [PubMed - as supplied by publisher]
14. Ogawa E, [Sakakibara R](#), Kishi M, Tateno F. Constipation triggered the malignant syndrome in Parkinson's disease. *Neurol Sci*. 査読有 2011 Jul 20. [Epub ahead of print]
15. Tateno F, [Sakakibara R](#), Kishi M, Ogawa E, Terada H, Ogata T, Haruta H. Sensitivity and specificity of metaiodobenzylguanidine (MIBG) myocardial accumulation in the diagnosis of Lewy body diseases in a movement disorder clinic. *Parkinsonism Relat Disord*. 査読有 2011 Jun;17(5):395-7.
16. Tateno F, [Sakakibara R](#), Kishi M, Ogawa E. Pure akinesia with low myocardial metaiodobenzylguanidine uptake. *Parkinsonism Relat Disord*. 査読有 2011 Jun;17(5):357-9.
17. Ogawa E, [Sakakibara R](#), Kawashima K, Yoshida T, Kishi M, Tateno F, Kataoka M, Kawashima T, Yamamoto M. VGCC antibody-positive paraneoplastic cerebellar degeneration presenting with positioning vertigo. *Neurol Sci*. 査読有 2011 Jun 16. [Epub ahead of print] PMID:21678073 [PubMed - as supplied by publisher]
18. Uchiyama T, [Sakakibara R](#), Yamamoto T, Ito T, Yamaguchi C, Awa Y, Yanagisawa M, Higuchi Y, Sato Y, Ichikawa T, Yamanishi T, Hattori T, Kuwabara S. Urinary dysfunction in early and untreated Parkinson's disease. *J Neurol Neurosurg Psychiatry*. 査読有 2011 Jun 13. [Epub ahead of print] PMID:21670077 [PubMed - as supplied by publisher]
19. Kishi M, [Sakakibara R](#), Nomura T, Yoshida T, Yamamoto M, Kataoka M, Ogawa E, Tateno F. Lateral medullary infarction presenting as isolated vertigo and unilateral loss of visual suppression. *Neurol Sci*. 査読有 2011 Apr 9. [Epub ahead of print] PMID:21479608
20. Tsunoyama K, [Sakakibara R](#), Yamaguchi C, Uchiyama T, Yamamoto T, Yamanishi T, Takahashi O, Sugiyama M, Kishi M, Ogawa E. Pathogenesis of reduced or increased bladder sensation. *Neurourol Urodyn*. 査読有 2011 Mar;30(3):339-43.
21. Kishi M, [Sakakibara R](#), Terada H, Ogawa E, Tateno T. Does levodopa affect metaiodobenzylguanidine myocardial accumulation in Parkinson's disease? *Mov Disord*. 査読有 2011 Feb 15;26(3):564-5.
22. Tateno F, [Sakakibara R](#), Kishi M, Yuasa T, Ogawa E, Takahashi O, Yoshio S, Sugiyama M, Uchiyama T, Yamamoto T, Yamanishi T. Progressive supranuclear palsy presenting with urinary retention and sleep apnea. *Clin Auton Res*. 査読有 2011 Jan 6. [Epub ahead of print] PMID:21210294 [PubMed - as supplied by publisher]

23. Yamamoto T, [Sakakibara R](#), Uchiyama T, Yamaguchi C, Nomura F, Ito T, Yanagisawa M, Yano M, Awa Y, Yamanishi T, Hattori T, Kuwabara S. Pelvic organ dysfunction is more prevalent and severe in MSA-P compared to parkinson's disease. *Neurourol Urodyn*. 査読有 2011 Jan;30(1):102-7.
24. Tateno F, [Sakakibara R](#), Kishi M, Ogawa E, Tsuyusaki Y, Yoshida T, Yamamoto M. Zoster lower cranial neuropathy: a case report and a review of literature. *Am J Case Reports*. 査読有 2011; 12: 137-139.
25. Ogawa E, [Sakakibara R](#), Yoshimatsu Y, Suzuki Y, Mouri T, Tateno F, Kishi M, Oda S, Imamura H. Crohn's disease and stroke in a young adult. *Intern Med*. 査読有 2011;50(20):2407-8.
26. Ogawa E, [Sakakibara R](#), Kishi M, Tateno F. Pure isolated internuclear ophthalmoplegia. *Intern Med*. 査読有 2011;50(16):1785.
27. Tateno F, [Sakakibara R](#), Sugiyama M, Takahashi O, Kishi M, Ogawa E, Uchiyama T, Yamamoto T, Yamanishi T, Yano H, Suzuki H. Meningitis-retention Syndrome: First Case of Urodynamic Follow-up. *Intern Med*. 査読有 2011;50(12):1329-32.
28. Ogawa E, [Sakakibara R](#), Tateno F, Kishi M, Nakagami T, Terada H. A case of brainstem hypertensive encephalopathy. *Am J Case Reports* 査読有 2011; 12: 95-97.
29. Watanabe M, Yamanishi T, Honda M, [Sakakibara R](#), Uchiyama T, Yoshida K. Efficacy of extended-release tolterodine for the treatment of neurogenic detrusor overactivity and/or low-compliance bladder. *Int J Urol*. 査読有 2010 Nov;17(11):931-6.
30. Asahina M, Akaogi Y, Misawa S, Kanai K, Ando Y, [Sakakibara R](#), Arai K, Hattori T, Kuwabara S. Sensorimotor manifestations without autonomic symptoms in two siblings with TTR Val107 familial amyloid polyneuropathy. *Clin Neurol Neurosurg*. 査読有 2010 Oct 11. [Epub ahead of print] No abstract available. PMID: 20943310 [PubMed - as supplied by publisher]
31. [Sakakibara R](#), Kishi M, Ogawa E, Tateno F, Ogata T, Haruta H, Matsuzawa Y, Shirai K. Dehydration encephalopathy: a neurological emergency in the older adults. *J Am Geriatr Soc*. 査読有 2010 Sep;58(9):1819-21.
32. [Sakakibara R](#), Kishi M, Ogawa E, Yuasa J, Isaka S, Uchiyama T, Yamanishi T. Dentatorubral pallidolusian atrophy presenting with urinary retention. *Mov Disord*. 査読有 2010 Sep 15;25(12):1996-7.
33. [Sakakibara R](#), Kishi M, Ogawa E, Takahashi O, Sugiyama M, Uchiyama T, Yamamoto T, Yamanishi T. Multiple-system atrophy presenting with low rectal compliance and bowel pain. *Mov Disord*. 査読有 2010 Jul 30;25(10):1516-8.
34. [Sakakibara R](#). Editorial comment to effect of dominant hemispheric stroke on detrusor function in patients with lower urinary tract symptoms. *Int J Urol*. 査読有 2010 Jul;17(7):660.
35. [Sakakibara R](#), Tsunoyama K, Takahashi O, Sugiyama M, Kishi M, Ogawa E, Uchiyama T, Yamamoto T, Yamanishi T, Awa Y, Yamaguchi C. Real-time measurement of oxyhemoglobin concentration changes in the frontal micturition area: an fNIRS study. *Neurourol Urodyn*. 査読有 2010 Jun;29(5):757-64.
36. Committee for Establishment of the Clinical Guidelines for Nocturia of the Neurogenic Bladder Society. Clinical guidelines for nocturia. *Int J Urol*. 査読有 2010 May;17(5):397-409.
37. Tateno F, [Sakakibara R](#), Kishi M, Ogawa E. Bupivacaine-induced chemical meningitis. *J Neurol*. 査読有 2010 Aug;257(8):1327-9.
38. Matsuzawa Y, [Sakakibara R](#), Shoda T, Kishi M, Ogawa E. Good maternal and fetal outcomes of predominantly sensory Guillain-Barré syndrome in pregnancy after intravenous immunoglobulin. *Neurol Sci*. 査読有 2010 Apr;31(2):201-3.
39. Matsuzawa Y, [Sakakibara R](#), Shoda T, Kishi M, Ogawa E. Good maternal and fetal outcomes of predominantly sensory Guillain-Barré syndrome in pregnancy after intravenous immunoglobulin. *Neurol Sci*. 査読有 2010 Apr;31(2):201-3.
40. Yamamoto T, [Sakakibara R](#), Nakazawa K, Uchiyama T, Shimizu E, Hattori T, Kuwabara S. Neuronal activities of forebrain structures with respect to bladder contraction in cats. *Neurosci Lett*. 査読有 2010 Mar 31;473(1):42-7.
41. [Sakakibara R](#), Uchiyama T, Yamanishi T, Kishi M. Genitourinary dysfunction in Parkinson's disease. *Mov Disord*. 査読有 2010 Jan 15;25(1):2-12.
42. [Sakakibara R](#), Tsunoyama K, Hosoi H, Takahashi O, Sugiyama M, Kishi M, Ogawa E, Terada H, Uchiyama T, Yamanishi T. Influence of Body Position on Defecation in Humans. *LUTS*. 査読有 2010; 2: 16–21.
43. Wyndaele JJ, Kovindha A, Igawa Y, Madersbacher H, Radziszewski P, Ruffion A, Schurch B, Castro D, [Sakakibara R](#), Wein A; ICI 2009 Committee 10. Neurologic fecal

- incontinence. *Neurourol Urodyn.* 査読有  
2010;29(1):207-12.
44. Wyndaele JJ, Kovindha A, Madersbacher H, Radziszewski P, Ruffion A, Schurch B, Castro D, Igawa Y, Sakakibara R, Wein A. Committe 10 on Neurogenic Bladder and Bowel of the International Consultation on Incontinence 2008-2009. Neurologic urinary incontinence. *Neurourol Urodyn.* 査読有  
2010;29(1):159-64. Review.
45. Takahashi O, Sakakibara R, Kishi M, Matsuzawa Y, Ogawa E, Sugiyama M, Uchiyama T, Yamamoto T, Yamanishi T, Tomaru T. Herbal medicine-induced meningitis-retention syndrome. *Intern Med.* 査読有 2010;49(16):1813-6.

[図書] (計 1 件)

1. Sakakibara R, Fowler CJ, Hattori T. Cambridge University Press. *Pelvic Organ Dysfunction in Neurological Disease: Clinical Management & Rehabilitation.* 2010, pages 349.

[その他]

ホームページ等

<http://www.lab.toho-u.ac.jp/med/sakura/neurology/>

## 6. 研究組織

### (1) 研究代表者

榊原 隆次 (SAKAKIBARA RYUJI)

東邦大学・医学部・准教授

研究者番号：00282476

### (2) 研究分担者

該当しない

### (3) 連携研究者

該当しない