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# (18F)-FDG PET/CT IN ESSENTIAL TREMOR: PRELIMINARY RESULTS

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## ABSTRACT

**Introduction:** A modest number of studies reported contradictory results for brain glucose metabolism in essential tremor (ET) patients.

**Aim:** To study the brain glucose metabolism in ET patients with (18F)-FDG PET/CT.

**Materials and Methods**: Ten patients were included, aged 60.4 years, with 8 months diseases duration. Five healthy persons, aged 60.2 years, were studied as controls. Resting state (18F)-FDG PET/CT was performed according to a standard protocol on a Phillips Gemini TF scanner. Images acquired were evaluated visually and quantitatively with specialized software NeuroQ, v. 3.0 for Phillips EBW workstation. Differences from database mean of more than ±2.5 SD were considered significant in both cluster and region analysis.

**Results:** Significant hypometabolism in left temporal, parietal and frontal cortical areas, including Broca's area and anterior cingulate cortex was found in 8 patients. One patient showed also significant hypermetabolism in cerebellar hemispheres, vermis, primary and associative visual cortical areas. Normal glucose metabolism was found in 2 patients and all the controls.

**Conclusion:** Our study confirmed the presence of functional abnormalities on (18F)-FDG PET/CT scans of ET patients in cortical and cerebellar areas and provides new data for possible changes in Broca's area, visual areas, and anterior cingulate cortex.

**Key words:** Brain glucose metabolism, (18F)-FDG PET/CT, Essential tremor

## INTRODUCTION

Growing evidences in the last decade suggest that essential tremor (ET) is not a benign monosymptomatic condition, rather a neurodegenerative disorder. A broad spectrum of motor and nonmotor symptoms was described with significant impact on quality of life [1, 2, 3]. A modest number of studies reported contradictory results for brain glucose metabolism in ET patients [4, 5, 6]. Therefore we decided to study the brain glucose metabolism in ET patients with (18F)-FDG PET/CT.

## MATERIALS AND METHODS

Ten patients were included (6 males), aged 60.4± 3.78 (54-64) years, with 8±3.43 (4-12) months diseases duration, diagnosed according to Deuschl's criteria [7]. Cases with head tremor were not included. All patients were right handed, and drug naïve. None of them reported dysautonomic symptoms [8], cognitive complaints (MMSA 28.7±1.06), nor past or present depressive episodes. The tremor was evaluated by Fahn-Tolosa-Marin rating scale (25.9± 2.6). Five healthy individuals (3 males), aged 60.2± 3.77 (54- 64) years, were studied as controls.

Resting state (18F)-FDG PET/CT was performed according to a standard protocol on a Phillips Gemini TF scanner. Images acquired were evaluated visually and quantitatively with specialized software NeuroQ, v. 3.0 for Phillips EBW workstation. Differences from database mean of more than ±2.5 SD were considered significant in both cluster and region analysis.

## RESULTS

Significant hypometabolism in left temporal, parietal, and frontal cortical areas, including Broca's area and anterior cingulate cortex was found in 8 patients (Table 1, Fig. 1 and 2).

**Table 1.** Regional analysis of hypometabolic zones.

| Patients | liLAT | lPCC | lsLT | lPTC | rPTC | lGFm | lGFd | lSM | lBroca | lGCa |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | n* | n | n | n | n | n | -2,51 | n | n | -3,86 |
| 2 | -3,45 | n | n | n | n | n | n | n | n | n |
| 3 | n | n | n | -2,85 | n | -3,25 | n | n | n | n |
| 4 | n | n | -3,05 | n | n | -2,65 | n | n | -2,62 | n |
| 5 | n | n | n | n | n | -3,08 | -2,69 | -3,25 | -2,95 | -3,1 |
| 6 | n | n | n | -2,58 | n | n | n | n | n | n |
| 7 | n | n | -3,48 | -2,61 | n | n | -3,27 | n | n | -3,17 |
| 10 | n | -2,94 | -2,53 | n | -3,23 | n | n | n | n | n |

***n**- normal result, d ±2,5 SD; **liLAT**- left inf lat ant Temporal Cortex; **lPCC**- left post Cingulate Cortex; **lsLT**- left sup lat Temporal Cortex; **lPTC**- left Parietotemporal Cortex; **rPTC**- right Parietotemporal Cortex; **lGFm**- left mid Frontal Cortex; **lGFd**- left medial Frontal Cortex; **lSM**- left Sensorimotor Cortex; **lBroca**- left Broca's Region; **lGCa**- left ant Cingulate Cortex

**Fig. 1 and 2.** (18F)-FDG PET/CT of patient No. 7 showing hypometabolism in lsLT, lPTC, lGFd and lGCa

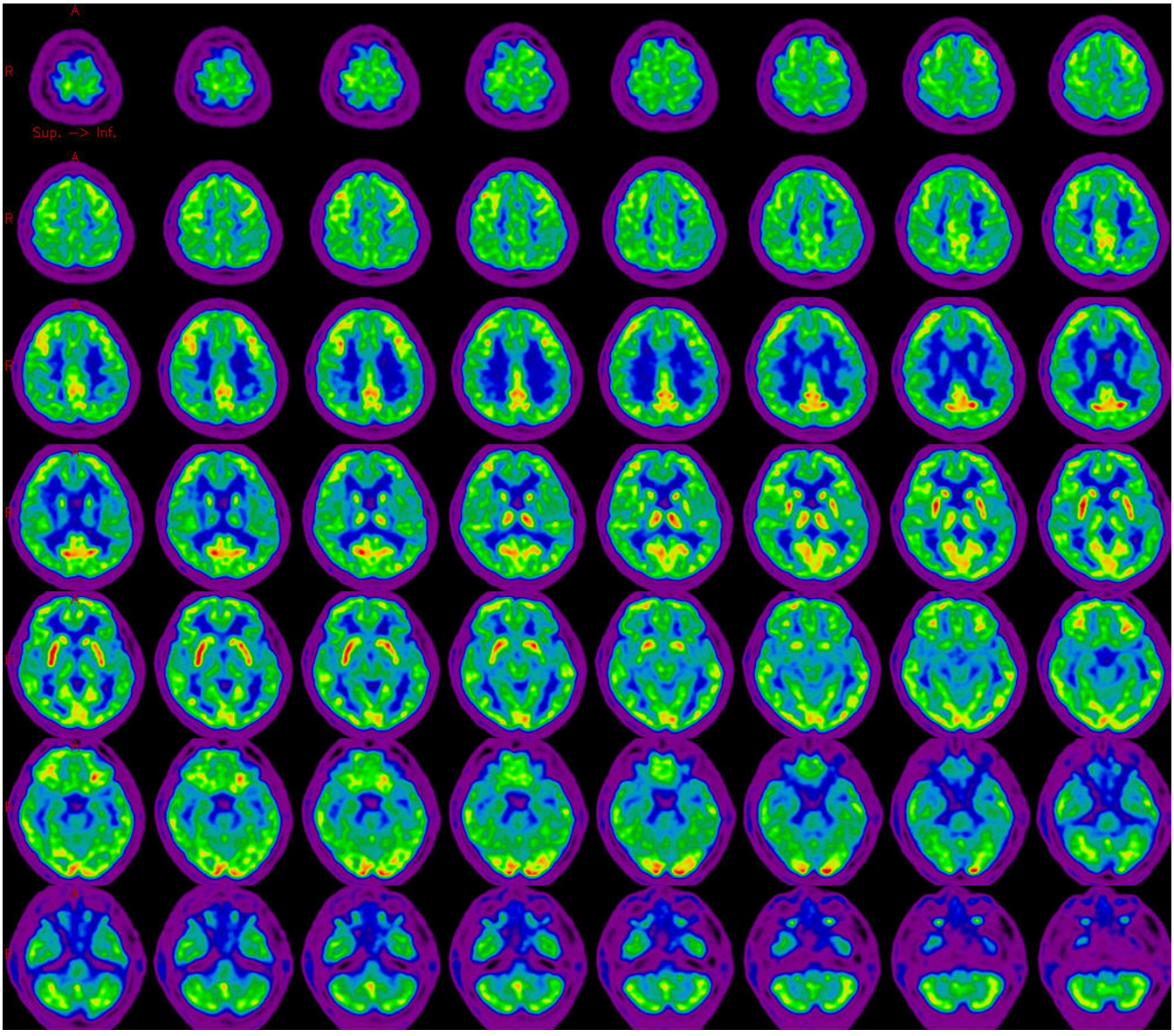
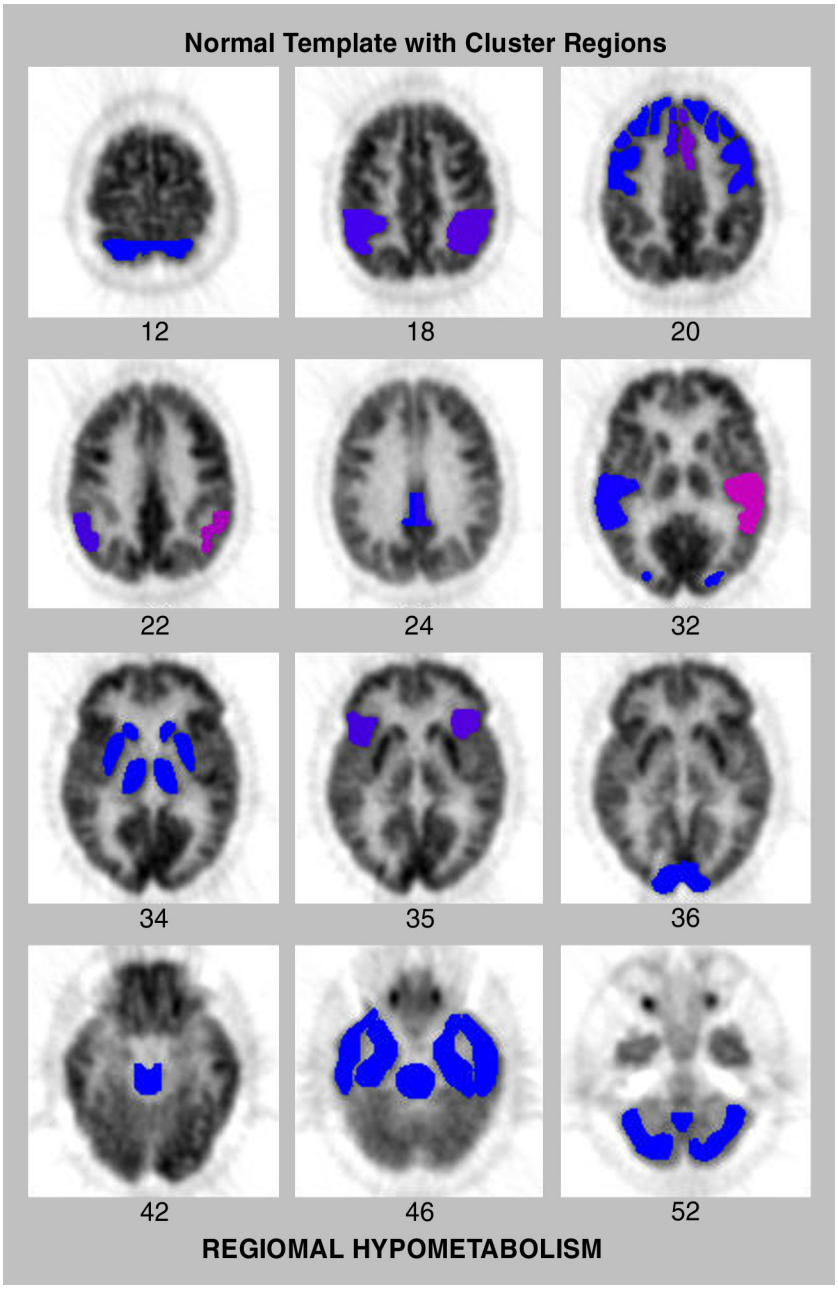


**Fig. 1.** (18F)-FDG PET/CT of patient No. 7 showing hypometabolism in lsLT, lPTC, lGFd and lGCa




One patient showed also significant hypermetabolism in cerebellar hemispheres and vermis, primary and associative visual cortical areas (Tabl. 2, Fig. 3 and 4).

**Table 2.** Regional analysis of hypermetabolic zones (patient No. 5).

| Patient | lAVC | rAVC | lCbm | rCbm | lPVC | rPVC | V |
|---|---|---|---|---|---|---|---|
| 5 | 3,22 | 3,49 | 4,31 | 3,09 | 2,89 | 3,1 | 3,83 |

**lAVC**- left Associative Visual Cortex; **rAVC**- right Associative Visual Cortex; **lCbm**- left Cerebellar hemisphere; **rCbm**- right Cerebellar hemisphere; **lPVC**- left Primary Visual Cortex; **rPVC**- right Primary Visual Cortex; **V**- Vermis

**Fig. 3 and 4.** (18F)-FDG PET/ CT of patient No. 5 showing hypermetabolism in lAVC, rAVC, lCbm, rCbm, lPVC, rPVC and V

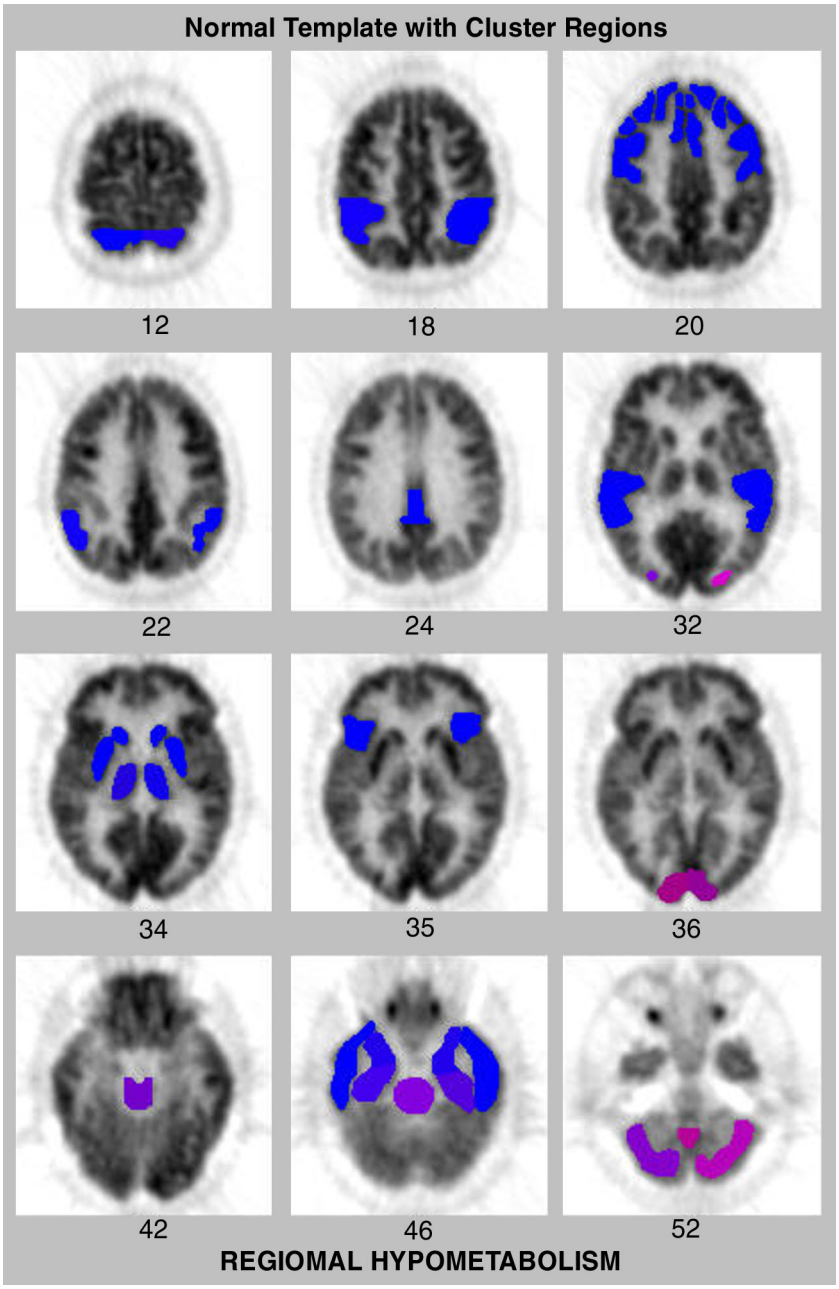
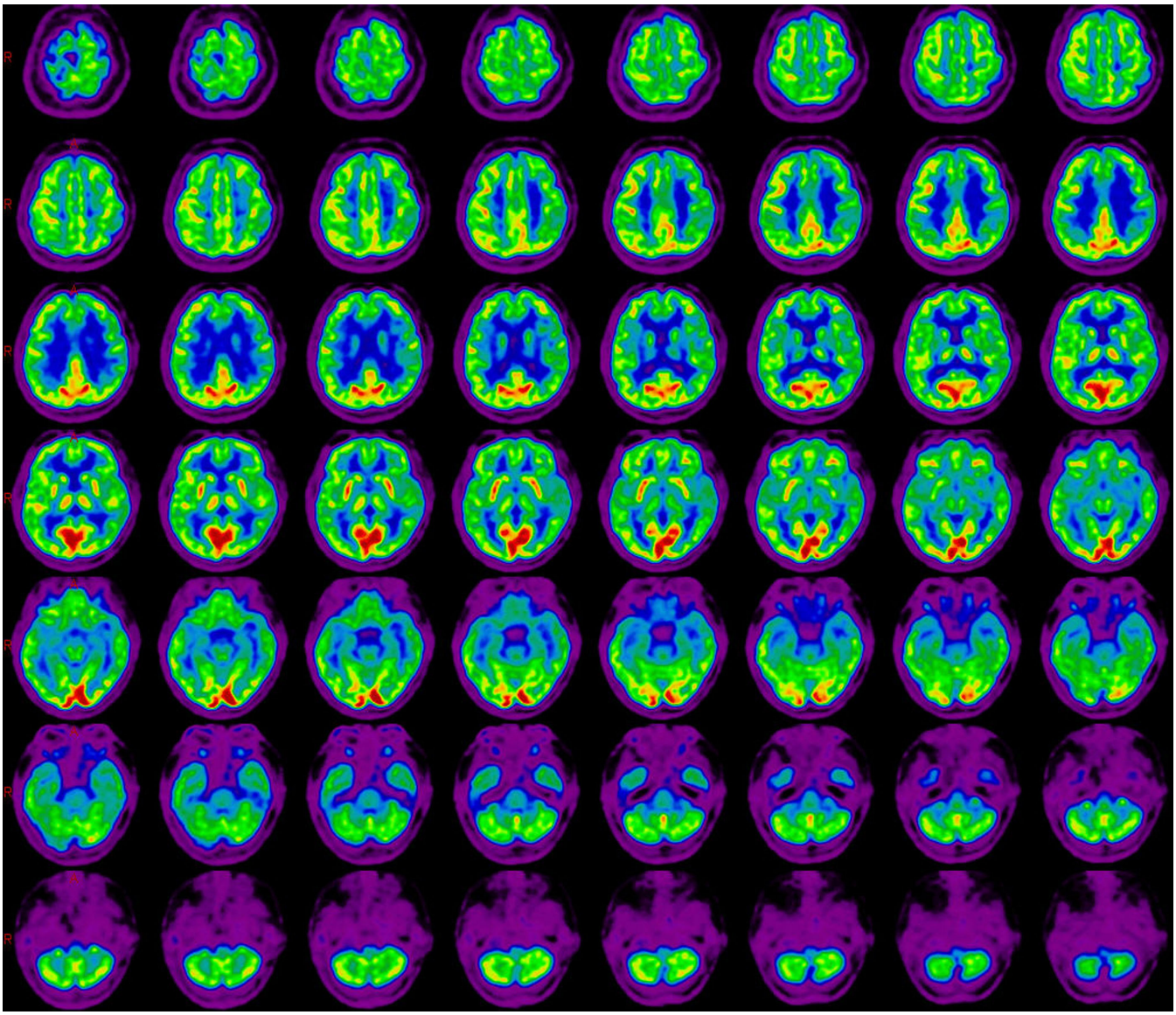


**Fig. 3.** (18F)-FDG PET/ CT of patient No. 5 showing hypermetabolism in lAVC, rAVC, lCbm, rCbm, lPVC, rPVC and V



Normal glucose metabolism was found in 2 patients and all the controls (Fig. 5 and 6).

**Fig. 5 and 6.** (18F)-FDG PET/ CT of patient No. 9 showing normal metabolism

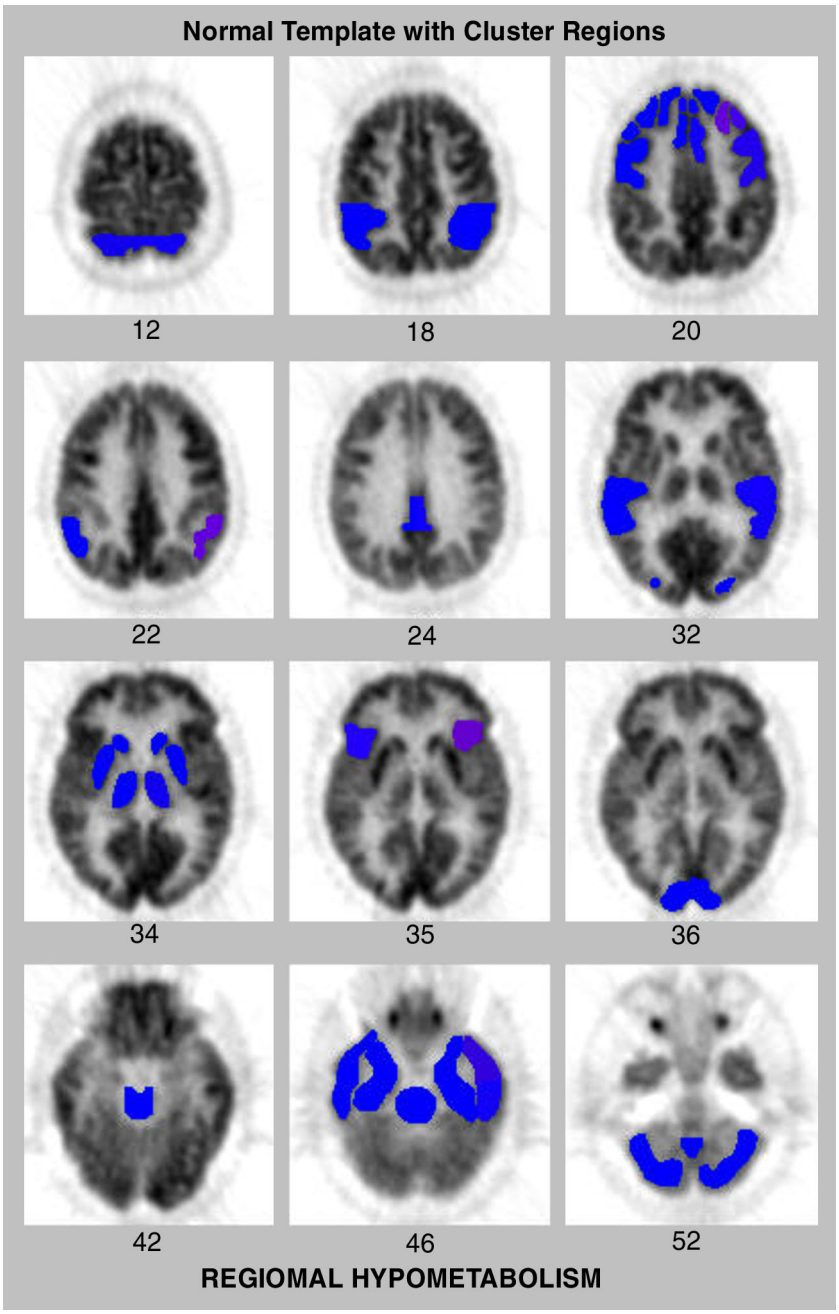
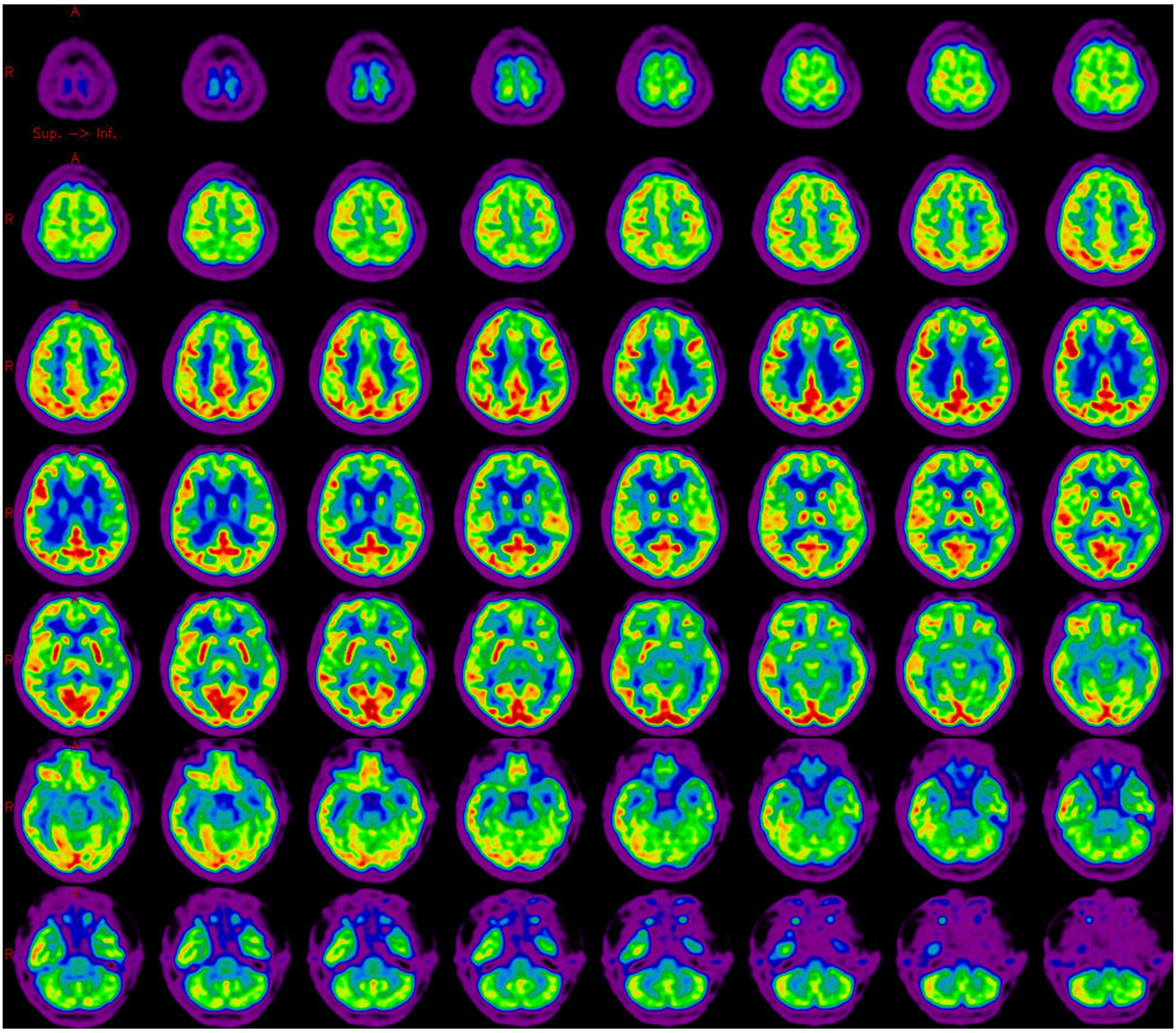


**Fig. 6.** (18F)-FDG PET/ CT of patient No. 9 showing normal metabolism




## DISCUSSION

Our results showed brain glucose hypometabolism in 8/10 patients (80%), almost entirely in the dominant hemisphere. We found functional deficits in frontal, temporal, and parietal cortical areas, anterior cingulated cortex, and Broca's area. Only one patient had also hypermetabolism: in cerebellar areas, and, unexpectedly, in primary and associative visual cortices.

Previous (18F)-FDG PET/ CT studies in ET reported different findings. A study from 1993 of 8 patients found hypermetabolism of the medulla and the thalami [5]. Researches from 2013 and 2014 in 12 and, respectively 17 patients, reported hypometabosim in primary motor cortices bilaterally and left posterior parietal area [6], and hypometabolism in medial frontal and temporal areas, and precuneus [4].

The variety of our and previously reported results might be due to the small number of patients studied, short disease duration of our contingent, and heterogeneity of ET itself [9, 10].

We selected patients less than 65 years of age to avoid potential age-related autonomic and cognitive decline, and with disease duration up to 1 year. Such short duration may be misleading for exact diagnosis and the patients could further develop full clinical picture of another neurodegenerative disease, explaining the unexpected areas involvement in our cases.

Our results for Broca's area changes may mark the presence of presymptomatic cognitive deficit. Anterior cingulate hypometabolism in our group might be a basis for further development of dysautonomic, cognitive or depressive symptoms. Hypermetabolism in primary and associative visual cortical areas is not previously reported and this case requires further observation. Our results support prior data for brain glucose metabolism abnormalities in ET [4, 5, 8]. These abnormalities, however, spread outside the motor zones and may be an early marker for nonmotor symptoms development.

In **conclusion** our study confirmed the presence of functional abnormalities on (18F)-FDG PET/ CT scans of patients with ET in cortical and cerebellar areas and provides new data for changes in Broca's area, visual areas, and anterior cingulate cortex. Further follow-up and more extensive investigations are required to elucidate the brain glucose metabolism in ET.

**REFERENCES:**


1. Bermejo-Pareja F. Essential tremor- a neurodegenerative disorder associated with cognitive defects? *Nature Reviews Neurology.* 2011 May; 7(5):273-282. [Pubmed] [CrossRef]

2. Chandran V, Pal P. Quality of life and its determinants in essential tremor. *Parkinsonism Relat Disord.* 2013 Jan; 19(1):62-65. [PubMed] [CrossRef]

3. Jhunjhunwala K, Pal P. The non-motor features of essential tremor: a primary disease feature or just a secondary phenomenon? *Tremor Other Hyperkinet Mov (NY).* 2014 Aug;4:255. [PubMed] [CrossRef]

4. Ha SW, Yang YS, Song IU, Chung YA, Oh JK, Chung SW. Changes in regional brain glucose metabolism measured with F-18-FDG-PET in essential tremor. *Acta Radiol.* 2014 Apr;56(4): 482-6. [PubMed] [CrossRef].

5. Hallett M, Dubinsky R. Glucose metabolism in the brain of patients with essential tremor. *J Neurol Sci.* 1993 Jan;114(1):45-48. [PubMed] [CrossRef]

6. Oh ES, Kim JM, Kwon HW, Kim YK, Moon BS, Lee BC, et al. Essential tremor has alterations in regional glucose metabolism and GABAergic system. [abstract]. *Mov Disord.* 2013; 28(Suppl 1):160.

7. Deuschl G, Bain P, Brin M. Consensus Statement of the Movement Disorder Society on Tremor. Ad Hoc Scientific Committee. *Mov Disord.*1998; 13(Suppl 3):2-23. [PubMed]

8. Ivanov B, Deleva N, Kaprelyan A, Dimitrov I. Questionnaire- based assessment of autonomic dysfunction in Parkinson's disease. *J of IMAB*. 2004; 10(1): 22-25. http://www.journal-imab-bg.org/en/vol-10_book-1.htm

9. Pan JJ, Lee M, Honig LS, Vonsattel JP, Faust PL, Louis ED. Alzheimer's-related changes in non- demented essential tremor patients vs. controls: links between tau and tremor? *Parkinsonism Relat Disord.* 2014 Jun; 20(6):655-658. [PubMed] [CrossRef]

10. Shill HA, Adler CH, Sabbagh MN, Connor DJ, Caviness JN, Hentz JG, et al. Pathologic findings in prospectively ascertained essential tremor subjects. *Neurology.* 2008 Apr;70(16 Part 2):1452-1455. [PubMed] [CrossRef]



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