



# The Reversed Clock Syndrome in Patient with Left Brain Tumor: A Case Report

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## Abstract

**Background:** The Clock Drawing Test (CDT) test was originally conceived as an examination of visuospatial neglect and inattention. Nowadays it is widely used in clinical neuropsychological practice. The Reversed Clock Syndrome (RCS) is an uncommon syndrome and its most evident manifestation consists in a reversed placement of the numbers on a clock without their omission. This phenomenon is usually the consequence of a lesion affecting the right cerebral hemisphere.

**Objective:** We report a clinical case of reversed clock phenomenon in a patient with a lesion of the left cerebral hemisphere associated with language, attention, memory and praxis disorders.

**Design:** Case report

**Patient:** A 64 years-Old Italian man was referred due to slight hemiparesis on the right side, memory deficit, dyscalculia and verbal production impairment.

**Results:** Pre-op Magnetic Resonance Imaging (MRI) showed the presence of a left parietal lesion in the posterior third of the gyrus cinguli. Overall, neuropsychological assessment indicated significant and widespread cognitive deficits in attention, memory, praxis, language and executive functions. Furthermore, the patient showed spontaneously reversed placement of the clock numbers without number omissions.

**Conclusion:** This case report underlies the difficulties to establish the exact lesion localization in the reversed clock-drawing task.

**Keywords:** Case report; Brain tumor; Clock reversed syndrome; Left lesion

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## Introduction

The Clock Drawing Test (CDT) is widely used in clinical neuropsychological practice and it has a sensitivity of approximately 70% to 75% [1]. It was used originally as an examination of visuospatial neglect and inattention [2]. In this test, a clinician gives the patient being tested a sheet of paper, often with a pre-drawn circle on it, and asks them to draw the numbers and hands of the clock that have to show a specific time. The assessment is based on identifying irregularities in the drawings, which may include omission of numbers, impaired number positioning, incorrect sequencing and missing clock hands [3]. The CDT actually provides information on a wide range of cognitive abilities [4], and this feature together with its brevity and ease of administration, has allowed the CDT to become a popular screening measure. The CDT requires several functions, such as semantic memory, visuo-constructional abilities and executive functions hence the several neural networks related to these functions [5].

The Reversed Clock Syndrome (RCS) is an uncommon syndrome and its most evident manifestation consists in a reversed placement of the numbers on a clock without omission during the CDT. The physiopathogenic mechanisms are not yet completely known. According to the literature regression is spontaneous after few days [6]. The RCS is usually the consequence of a lesion affecting the right cerebral hemisphere although Jones et al. [7] reported a patient with typical clinical manifestations of reversed clock phenomenon due to a left parietal lesion [6].

We would like to report an interesting case of a patient who presented a RCS due to a lesion of the left parietal lobe associated with language, attention, memory and praxis disorders.

## Case Presentation

### Patient information

Here we present Mr. PR, a 64-year-old right-handed man, retired warehouseman with 9 years of education and with an unremarkable past medical history. He was referred to the Emergency Department the first days of May 2021 because of the appearance of slight hemiparesis on the right side, memory deficit, dyscalculia and impairment in the verbal production; these neurological manifestations appeared a few days beforehand.

Transferred to the Neurosurgical Ward, the patient was vigilant, responsive and spatiotemporal oriented.

## Material and Methods

### Preoperative imaging

Initial CT brain scan revealed a left parietal lesion, near the midline, with perilesional edema. On the pre-op MRI, the lesion that extended to the left posterior gyrus cinguli, was hyper intense and surrounded by conspicuous perilesional edema in flair; the T2 GRE sequence showed bleeding signs. After the paramagnetic medium infusion, the lesion presented an intense and dishomogeneous enhancement (Figure 1).

### Neuropsychological assessment

Neuropsychological assessment was carried out by a clinical psychologist the day before surgery. The assessment included tasks on the following topics: attention (Trail Making Test-TMT) [8], memory (immediate and delayed recall), praxis (complex figure copy), language (semantic and phonological verbal fluency; word, non-word and sentence reading and writing; number reading; calculation; object and action picture oral and writing naming; visual and oral sentence comprehension) and executive functions (Stroop test [9], Raven's Progressive Matrices [10]). The depression and anxiety psychological assessment were carried out too.

### Clock drawing test assessment

The clock-drawing task was performed the day before surgery and 3 days after surgery by giving instructions to the patients to place the numbers of a clock on a previously drawn circle and to set the time to a quarter to three. Based on his age and education the cut-off was 7 [11].

### Surgical procedure

Under general anesthesia and with the aid of the intraoperative neuronavigation system, standing in park bench position, the patient was operated on through a right parieto-occipital craniotomy to expose the posterior third of the superior sagittal sinus and the falx. Access to the lesion was performed through a contralateral trans-falx route. The final histological analysis showed the diagnosis of glioblastoma IDH wild type (Gr. IV, WHO 2016).

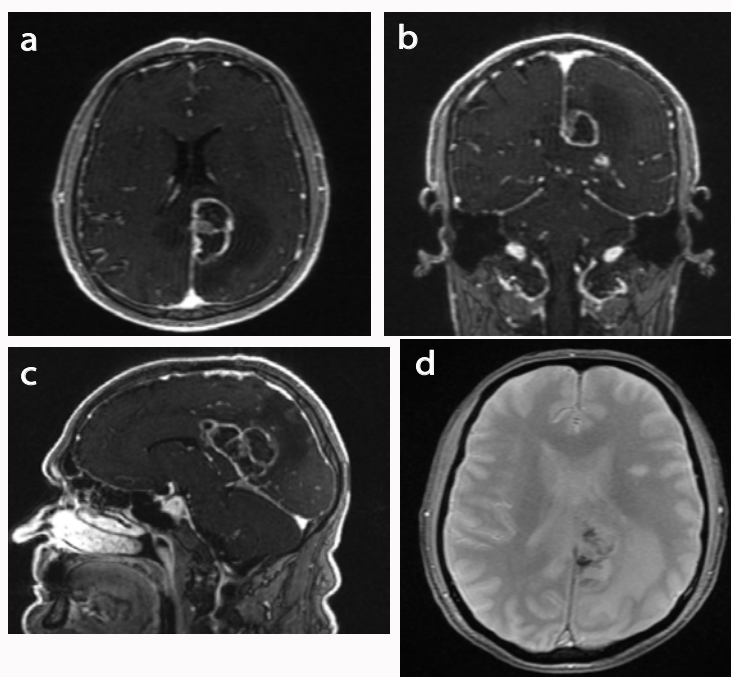
## Results

### Neuropsychological assessment

Mr. P.R.'s responses on the psychological battery indicated adequate depression and state of anxiety.

Overall, the test performance indicated significant and widespread cognitive deficits in attention, memory, praxis, language and executive functions. The score of neuropsychological tests are reported in Table 1.

In comparison with normative data, there were impairments in search speed, mental flexibility and task switching. The patient reported low score in memory and learning ability in the auditory-verbal domain, visual long-term memory whereas the verbal working memory was border line. In the complex figure copy the patient obtained a raw score under the media confronted with normative data. The patient underwent a comprehensive language assessment that showed deficit in reading (words, non-words and sentences), writing (words, non-words and sentences), calculation ability



**Figure 1: a-c):** Pre-operative MRI T1 post-contrast sequence showing the location of the lesion at the posterior third of the left gyrus cinguli; Axial, Coronal and Sagittal; **d):** T2 GRE shows bleeding signs within the lesion.

**Table 1:** Results of the patient's neuropsychological assessment.

Test	Range	Raw score	Adjusted score	Cut-off
<b>Attention</b>				
TMT A	0-∞	53	36	>93
TMT B	0-∞	307	249	>282
TMT B-A	0-∞	254	213	>186
<b>Memory</b>				
Digit span forward	0-9	6	5.83	<4.25
Digit span backward	0-8	3	2.81	<2.64
15-word immediate learning	0-75	26	28.3	<28.52
15-word delayed recall	0-15	1	1.7	<4.68
Complex figure delayed recall	0-36	6.5	7	<9.47
<b>Praxis</b>				
Complex figure copy	0-36	24.5	25.5	<28.88
<b>Language</b>				
Verbal fluency phonemic cue	0-∞	27	32.91	<17.77
Cue				<28.34
Verbal fluency semantic	0-∞	42	47.33	<6.4
<b>Category</b>			6.3	<4
Word reading	0-10	9	2	<1.3
Non-word reading	0-5	2	0.9	<6.3
Sentence reading	0-2	9	5.4	<1.4
Word writing	0-10	6	0.3	<0.6
Non-word writing	0-5	1	0	<7.6
Sentence writing	0-2	0	7.3	<2.2
Number reading	0-10	8	2.3	<1
Calculation addition	0-3	3	0.8	<1.4
Calculation subtraction	0-3	1	2.4	<8.2
Calculation multiplication	0-3	3	10	<6.1
Noun naming	0-10	10	9.5	<2.7
Picture naming	0-10	10	3.9	<3
Noun writing	0-5	4	4.6	<11.3
Picture writing	0-5	5	13.6	<11.6
Written sentence comprehension			13.9	
Auditory sentence comprehension	0-14	14		
<b>Executive functions</b>				
Stroop test interference on errors	0-30	0	0	>4.24
Stroop test interference on time	0-∞	34	28.75	>36.92
Raven's progressive matrices	0-36	18	20.5	<17.5

Adjusted scores are raw scores corrected by age, education level, and gender when required. Pathological scores are highlighted in bold

(subtraction) and number reading.

**Clock drawing test assessment**

The patient showed spontaneously reversed placement of the numbers of a clock without number omissions in both assessment (pre and post-op). Also Mr. P.R. drew the hands in the opposite direction of what was required according to the hour specified by the examiner (Figure 2). On the contrary, he had not difficulty reading the hour on a clock (Table 2).

**Table 2:** Results of the patient's clock drawing assessment before surgery and 3 days after surgery.

Time of assessment	Range	Raw score	Adjusted Score	Cut-off
Before surgery	0-10	4	4	<7
3 days after surgery		4	4	<7

Adjusted scores are raw scores corrected by age, education level, and gender when required. Pathological scores are highlighted in bold

**Discussion**

Reversed clock drawing is a transient phenomenon caused by either subcortical or cortical lesions in the right hemisphere [6]. It was especially studied in patients with stroke [6,7] or Alzheimer [1,12].

This is the first reported case of patient with left brain tumor lesion presented the RCS.

This phenomenon has been reported to date just in 8 stroke patients, 7 of whom with a right-sided ischemia, mainly in the temporo-parietal region or in the basal ganglia-internal capsule [6,13], and just 1 patient with a left side lesion [7]. But, in this last case, it does not seem to be related to a specific cortical or subcortical location. It can be due to a lesion that interrupts any components of the cerebral network with a right dominant responsible for spatial attention and visuospatial tasks [14]. Kumral et al. [6] raised the possibility that this disruption could especially affect the systems of perception or motor exploration based on external world coordinates.

Brugnolo et al. [12] found that Alzheimer patients with CDS had hypo-perfusion in the right superior temporal gyrus (BA38 and BA22) and in the left insula. It has been suggested that the phenomenon is the consequence of the disruption of attentional and visuospatial networks, allowing correct allocation of objects in space and mainly attributed to parietal dysfunction, with a strong right prevalence.

A previous study on Alzheimer patients showed that the blood flows in the left parietal, angular regions, bilateral hippocampal and pericallosal regions of patients with low performance in CDT were significantly reduced compared with those of patients with high CDT performance [1]. This study underlined that CDT score correlates with immediate and delayed visual memory scores and suggested that CDT score may be affected by memory and construction ability, as described in our patient.

Another study conducted on neurological patients with focal brain damage found two type of error: (1) impaired spatial organization, usually together with impaired number placement and/or omission of numbers; and (2) impaired time (clock hands) setting, in the context of a relatively well drawn clock that had all the numbers in approximately the correct spatial locations. The second error pattern was much more frequent in subjects with left hemisphere lesions, in particular in the inferior frontal-parietal opercular cortices, with foci in the inferior frontal gyrus, the lower portion of the pre-central and post-central gyri, the anterior portion of the supramarginal gyrus, the insula and the underlying basal ganglia [15]. Furthermore, the patients with impaired time setting demonstrated lower performances on several language-related tests: Controlled Oral Word Association, Token test and Boston Naming Test. On the contrary, subjects with impaired spatial organization did not commit errors on the language-related measures. So, these results support the notion that the CDT defects in the Impaired Time Setting group tended to be related to deficits in language processing, whereas CDT defects in the Impaired Spatial Organization group tended to be

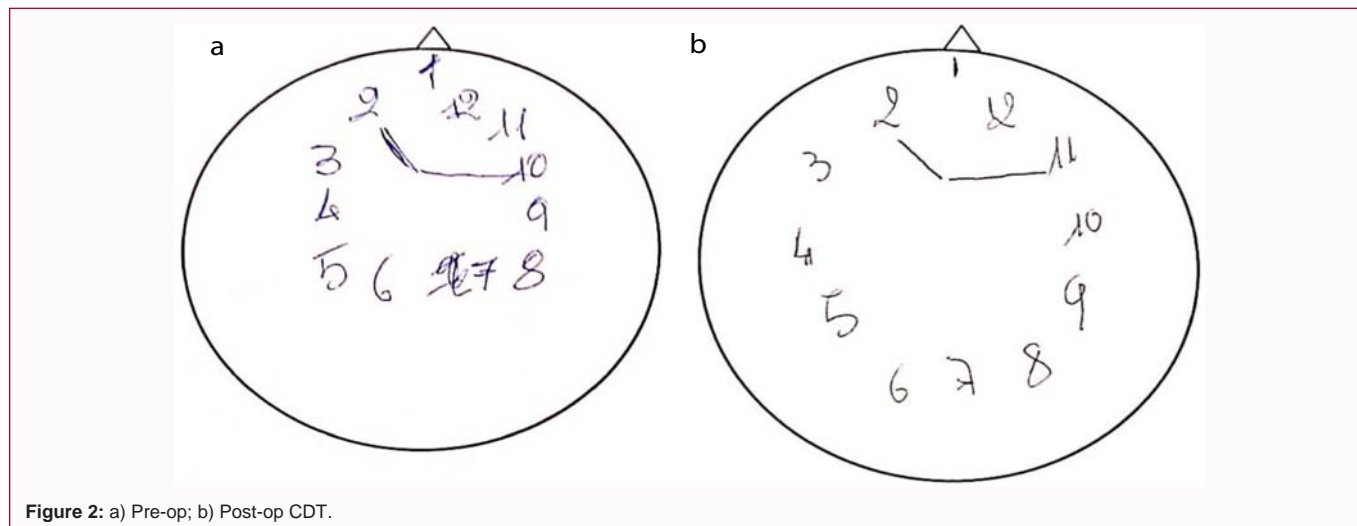


Figure 2: a) Pre-op; b) Post-op CDT.

related to visuo-constructional and visuospatial processing defects. The authors found a significant lesion-deficit relationship between impaired CDT performance and right parietal damage, but this relationship was not specific to error type. Also, these data suggested that the presence of a right sided parietal lesion substantially raises the probability of obtaining poor score on the CDT, but having impaired CDT performance is not especially predictive of right parietal damage [15].

In our patient we found a mixed profile because he showed language problems, as reported by Tranel et al. [15], but he also presented an impaired spatial organization, typically presented in right parietal lesions.

## Conclusion

RCS is an uncommon complication typically of the right hemisphere lesion that usually improves in a few days. Here we reported a singular case ever described in literature of a patient with left brain tumor lesion with RCS. This case report underlies the difficulties to establish the exact lesion localization in the reversed clock-drawing task.

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