

Research Paper

## Neuropsychological profile of an adult with major neurocognitive disorder secondary to a primitive neuroectodermal tumor of the central nervous system

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### ABSTRACT

This research is about a case study of an adult with diagnosis and resection of primitive neuroectodermic tumor of the central nervous system. This report describes their cognitive functioning after surgical and pharmacological treatment. This case is relevant because tumors of this category are of strange appearance in adults. For the evaluation of cognitive functions, a neuropsychological evaluation protocol was used, consisting of: Scale activities of daily living, Goldberg scale, Subjective complaint of memory and / or scale of memory disorders (QSM), Abbreviated neuropsychological examination program, Test Barcelona abbreviated (TB-A), Young NEURONORMA Program, BANFE II Neuropsychological Battery of Executive Functions and TBDA Boston test for the diagnosis of Aphasia. Significant alterations were found in advanced activities of daily life (AADL) and major neurocognitive disorder. This article constitutes a contribution to the knowledge of the neuropsychological functions that are affected in a case of a brain tumor, which, according to what is reported in the literature, due to its histology is of rare appearance in adults. This type of neuropsychological profiles allow the design of pertinent and effective rehabilitation plans.

**Keywords:** *Major neurocognitive disorder; Primitive neuroectodermal tumor, Neuropsychology.*

The concept of brain tumor encompasses a large number of neoplasms that vary according to the patient's age, location in the brain, its etiology, the treatments received and the degree of malignancy. For example, benign tumors grow outside the brain, as is the case of meningiomas that remain well defined and do not infiltrate the brain parenchyma, so surgical resection is relatively easy and once removed, usually do not they develop again; contrary to what happens with malignant tumors, which frequently arise in glial cells, they infiltrate and become confused with brain tissue (Ardila, 2007).

Regarding its etiology, brain tumors are classified as primary if they are born in the nervous system and secondary or metastases if they originate due to the transport of cells from

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Received: April 23, 2020; Revision Received: May 20, 2020; Accepted: June 25, 2020

## **Neuropsychological profile of an adult with major neurocognitive disorder secondary to a primitive neuroectodermal tumor of the central nervous system**

another point of origin of the brain (Ardila, 2007). Primary tumors are the third leading cause of cancer death in adults and the first in children. They make up 10% of CNS tumors, since 90% are metastases. Clinical manifestations are due to the increase in intracranial pressure (headache, nausea, instability and involvement of cranial nerves), reorganization of the cytoarchitecture of the cortex (epilepsy) and focal functional deficits (paresis, apraxias and cognitive deficits) (Gómez, Navarro, López, Lamarca, and Álvarez, 2013). Thus, childhood tumors, unlike in adults, there is less interaction between genetic and environmental factors. As for the predisposing genetic factors to develop a brain tumor, 4% of brain tumors are associated with hereditary syndromes or multifactorial genetic diseases. The inherited syndromes with greater tumor predisposition in the CNS are: Neurofibromatosis I and II, Tuberous Sclerosis, von Hippel-Lindau disease, familial polyposis syndrome and nevoid basal cell carcinomatous syndrome. The standardized incidence rate for a brain tumor among family members is 2.55% and sex is also a risk factor for certain brain tumors (Martínez, García, Garaizar, 2008).

According to their histology and biological behavior, they can be classified as astrocytic, neuronal and neuroglial, ependymal, choroidal plexus, meningeal, germ cell and embryonic tumors (Martínez, García, Garaizar, 2008).

Astrocyte tumors, are the most common primary CNS tumors in children and adults, representing 30-40% of them, among which are diffuse astrocytic tumors of infiltrative character and those that constitute localized lesions. They are mainly classified as pilocytic astrocytoma, pleomorphic xanthoastrocytoma and subependymal giant cell astrocytoma, which have in common a degree of malignancy that ranges from II to IV, although most are low grade (Ortega and Romero, 2004).

On the other hand, neuronal and neuroglial tumors have in common the presence of more or less extensive neuronal differentiation. Almost all types that make up the group imply a good prognosis and correspond to degrees I or II of malignancy. Generally, these tumors are located in the temporal lobe, are associated with treatment-resistant epilepsy and in 5% of cases with congenital dysplastic abnormalities (Ortega et al, 2004).

On the other hand, choroid plexus tumors, which constitute the most frequent congenital neoplasms, are located in the ventricles and are derived from the epithelium of the choroid plexus or its specific progenitor cells. Additionally, they are classified histologically into a benign variant, choroid plexus papilloma (World Health Organization grade I - WHO) and a malignant variant, choroidal plexus carcinoma (grade III). Papillomas and carcinomas constitute 3-5% of intracranial tumors in pediatric age and less than 1% of all primary intracranial neoplasms in adults. (Solís, López, Tello and Sirvent, 2011)

As for meningeal tumors, they are derived from cells that are located in the arachnoid villi and make up the second most frequent group of CNS tumors, only preceded by gliomas. They constitute 15 to 20% of brain tumors and the majority are intracranial presentation (Miranda, Larralde, Alvarado, Barboza and Ancer, 2010).

Regarding ependymal tumors, as indicated by Ortega and Romero (2004), "They are neuroepithelial tumors derived from cells that express ependymal differentiation. They can be located in any region along the ventricular system and spinal canal, but 70% of the intracranial ones do so in the posterior fossa; of these, half originates in the floor of the

## **Neuropsychological profile of an adult with major neurocognitive disorder secondary to a primitive neuroectodermal tumor of the central nervous system**

fourth ventricle,” which generally cause an early obstruction of cerebrospinal fluid circulation.

On the other hand, germ cell tumors are considered infrequent in the central nervous system, however, they are one of the most common congenital brain tumors; They are usually located in the midline especially in the pineal region. They are divided into germinomas, which usually occur in the first two decades of life and intracranial teratomas, which, according to the degree of differentiation, are classified as mature, immature or malignant (Ortega and Romero, 2004).

In the case of embryonic tumors, whose formation is due to embryonic (fetal) cells that remain in the brain after birth, are characterized by being very frequent in childhood, but infrequent in adults, contrary to what happens with meningiomas. For this reason, primary neurogenic neoplasms comprise 80 to 90% of intracranial tumors (ICT) in children under 15 years of age and are located within the cranial cavity. (Ramos, Arroyo, Salazar and Olvera, 2005).

In the group of embryonic tumors, there is the primitive neuroectodermal tumor (TNEP), which will be described in detail because it is of special interest for the present case study. TNEPs are known for their easy distribution through the nervous system and are histologically characterized by undifferentiated cells; they are similar to malignant tumors that arise in intracranial and peripheral regions of the nervous system and tend to spread along the cerebrospinal fluid pathways (Páez and Archudia, 2011). However, they are currently widely discussed for their origin and classification. Kleihues, Burger, Scheithauer, et al (1993) cited by Zapata and Rivera (2004), distinguish three classes of TNEP, based on the classification presented by the World Health Organization (WHO) in 2000, as follows: 1. TNEP, 2. TNEP with astrocytic, ependymal and neuronal differentiation and 3. Medulloblastoma.

In the TNEP, its topographic specificity is very characteristic, 50% are infratentorial and 90% of those given in adults are supratentorial. In this sense, supratentorial primitive neuroectodermal tumors (TNEPst) represent less than 2.8% of CNS embryonic tumors, they are rapidly growing tumors, with different degrees of differentiation (undifferentiated, differentiation to glial cells, ependymal cells, neuronal, with multipotential differentiation, including melanocytes or muscle). The location of these tumors is in the frontal, temporal and parietal lobe, the reported in the occipital lobe are very scarce. (Becker and Hinton, 1983). According to Cortés, González and Revilla (2011), 80% of the diagnoses correspond to children under 10 years, in adults this is considerably sporadic, finding only 57 cases reported in the literature.

Regarding the neuropsychological characteristics, people with CNS tumors, present alterations at cognitive level characterized by deficits in memory, praxias, language, executive functions, gnosis and verbal learning, which significantly impact the quality of life and the mood of the patient. (Sanz, Olivares and Barcia, 2011). Factors such as age, tumor characteristics, progression, concurrent medical diseases, medications, chemotherapy, neurosurgery and radiotherapy will determine the semiology of each case, as well as the course of the disease (Olvera-Manzanilla, 2011). In this sense, Cortés et al (2011), present the case of “a 36-year-old man with a tumor in the left frontotemporal lobe, with a history of craniotomy in December 2007 and histopathological diagnosis of ependymoma; who goes to

## **Neuropsychological profile of an adult with major neurocognitive disorder secondary to a primitive neuroectodermal tumor of the central nervous system**

assessment for speech and gait disturbances, again receiving tumor resection on February 11, 2008. The histopathological study indicated primitive neuroectodermal tumor with extensive glial differentiation. The patient was discharged from the hospital with symptomatic improvement, without tumor data in imaging studies and started oncological treatment with radiotherapy. On February 23 of the same year he came to a new assessment for presenting syncope, disorientation and again motor aphasia”.

Some CNS tumor survivors have symptoms compatible with attention deficit hyperactivity disorder, this being secondary to the disease and / or the neurotoxicity of the treatments, so it is necessary to identify it as such and not as a premorbid disorder. In other cases, mainly if the tumor is located in the frontal lobes, there is the development of dementias secondary to neoplasia, or a global deterioration of the cognitive and behavioral function of the individual (Peña, 2007) At a behavioral level, they present symptoms such as: apathy, depression, slowness in the processing of information, loss of the ability to maintain attention for prolonged periods of time, agitation, confusion, alterations in sleep cycles and appetite. Progressively there may be a loss of interest in activities of daily living, irritability, emotional lability, inertia and low capacity to monitor their own behavior (Ruiz & Porta-Estessam, (2007) cited by García, 2013).

Due to this, neuropsychological evaluation brings the following as its main objectives: 1. Verify the existence of cognitive disorders related to brain damage; 2. Determine the relative magnitude of the damage; 3. Establish the patient's ability to return to a previous lifestyle (Ardila, 2009).

Therefore, when a neuropsychological evaluation is performed in a patient diagnosed with brain tumor, it is important to consider at least four factors that influence their current symptomatology: 1. Specific location of the tumor, due to the local damage it causes on brain tissue; 2. The size of the tumor, which correlates with the amount of tissue affected, with the general displacement of brain structures and with the presence of intracranial hypertension; 3. Invasion of brain tissue, since the tumor may be within the brain parenchyma or simply be exerting a pressure effect on the brain mass; 4. Growth speed, since rapidly growing tumors have a much more acute symptomatology, while those with slow growth favor the existence of permanent processes of retraining and relearning (Ardila, 2009).

Regarding treatment, in all age groups, the widest possible surgical resection is included, followed by craniospinal radiation, for which there are irradiation models (National Radiotherapy Consensus, INOR, 1997); to which various schemes of chemotherapy and other medications are also incorporated, but with contradictory and generally unsatisfactory results (Alert and Jimenez, 2004). Non-pineal TNEPs may be resistant to some chemotherapy regimens, so the scheme to be used and investigate other alternative schemes should be reconsidered (Páez and Archundia, 2011). However, Pérez, Quintero, González, Sevilla, Díaz and Madero (2004) affirm that multidisciplinary treatment with surgery, radiotherapy and chemotherapy has allowed improving the overall survival of patients with TNEPs and medulloblastomas (MB), until they are currently around 50-70% According to Zapata and Rivera (2004), the factors included in the prognosis depend on the histopathological variety. The most used in pediatrics are: 1) Type of initial surgery: magnitude or percentage of resection. 2) Age: older or younger than three years. 3) Location: supra or infratentorial.

## **Neuropsychological profile of an adult with major neurocognitive disorder secondary to a primitive neuroectodermal tumor of the central nervous system**

Considering the above, patients under three years have a worse prognosis and morbidity increases with radiotherapy. Additionally, the size and proximity of some affected anatomical structures limit the extent of surgical treatments. Thus, for example, in low-grade tumors, radiation therapy plays a key role and makes a substantial difference in survival, as well as in the quality of life. However, myelin toxicity, which in the long term causes motor, cognitive and behavioral alterations, has limited its use in children under three years since at this age the myelination process has not been completed. On the other hand, the anatomic location of the tumors is important for the prognosis. Thus, supratentorial neoplasms have a better prognosis than infratentorial neoplasms because neighboring structures can be damaged during surgery or radiotherapy that limit the extent of treatments; neoplasms originating in the midline have a better prognosis in general than those originating in the cerebral hemispheres (Zapata and Rivera, 2004)

Gómez, Navarro, López, Lamarca, and Álvarez (2013), affirm that surgery is effective while respecting the eloquent cortex; it cures most benign tumors and increases survival in malignant ones. Stereotactic radiotherapy and radiosurgery are useful for benign tumors and metastases. According to the authors, the future lies in the local administration of chemotherapy, in the use of more selective collimators for radiotherapy and surgery guided by neuronavigation or ultrasound. However, García (2013) states that after a resection, the sequelae of the disease and treatment are both physical and cognitive. In studies conducted with patients who suffered CNS tumors, a decrease in IQ, verbal and visuospatial skills, attention deficit, memory, psychomotor speed, executive functioning and learning was found (Sanz, Olivares and Barcia, 2011).

Consistent with the foregoing, some authors claim that the systematic and intensive use of chemotherapeutic drugs, irradiation or the combination of the two in order to attempt a cure in various types of cancer, leads to short-term and long-term adverse effects. . The toxicity that these chemical agents cause to the brain cells and the events triggered by the radiation are common bringing about alterations reflected in various neuropsychological deficits especially in: attention, speed of processing, memory and executive functions, affecting the quality of life of the survivors (Gómez, 2011).

The drugs used in chemotherapy appear to do greater damage to normal cells than to cancer cells causing the death of neuronal and glial precursors (especially oligodendrocytes), suppression or reduction of the division of vital progenitor cells for processes of repair and neuronal repopulation as well as dysfunction in cell differentiation. Radiation therapy, on the other hand, causes necrotic processes and leukoaraiosis, which involve alterations of hippocampic neurogenesis as well as lesions in the white matter causing leukoencephalopathy, epilepsy or lethal cerebral infarction, generating long-term sequelae in the form of cognitive deficits that are devastating in the reparative processes in adults (Gómez, 2011).

Finally, CNS TNEPs are one of the worst prognosis neoplasms for both children and adults. As mentioned in the literature, it can be inferred that early age, tumor necrosis and tumor spread are very serious prognostic factors; while pineal location and complete resection suggest a favorable prognosis. However, in other cases, no correlation was observed between survival and the degree of resection or chemotherapy (Cortes, Gonzalez and Revilla, 2011). In this way, neuropsychological evaluation is essential to determine if there is a deficit in order to train the patient in a process of habilitation and rehabilitation,

## **Neuropsychological profile of an adult with major neurocognitive disorder secondary to a primitive neuroectodermal tumor of the central nervous system**

specifying changes and social adjustments as well as educational and environmental adjustments that patients themselves must perform in order to improve their quality of life.

Next, the neuropsychological alterations that make up the major neurocognitive disorder secondary to neoplasia are described, which was diagnosed in this case study patient, which are derived from resection of the TNEP in the left frontotemporal region.

### ***Major neurocognitive disorder secondary to neoplasia***

Secondary dementias are those caused by a non-degenerative neurological disorder. They can be of vascular, infectious, deficiency, endocrinometabolic, toxicological or other medical conditions that in their clinical evolution can end up developing dementia, as occurs with neoplasms (Peña-Casanova, 2007; Rincon Barreto, 2018)

In the literature reviewed it was found that 8.6% of all cases of dementia are caused by neoplastic disease and the initial clinical presentation of brain metastases such as rapidly progressive dementia (RPD) is quite unusual. In some cases, it begins with frequent forgetfulness of daily activities, temporary disorientation, lack of attention and alterations in behavior (apathy). The previous symptoms are accentuated and difficulty is added to nominate objects, to constructive activities, alteration of the reading-writing, sleep disorders, difficulty to recognize relatives and dressing apraxia, as well as urinary incontinence and psychomotor agitation (Flórez, Zúñiga and Alvarado, 2006)

Finally, it is important to keep in mind that tumors in the frontal region cause cases of cognitive deterioration that progresses slowly - subacute-. These symptoms are not always accompanied by physical neurological signs, so they do not always see a doctor early. Generally, resection of these tumors may damage the adjacent parenchyma (Torralva and Manes, 2005); causing subacute intellectual deterioration that can be confused with the onset of dementia or what is now known as neurocognitive disorder.

## **METHODOLOGY**

### ***Patient's background***

25-year-old man (CD), right-handed laterality, native of Cartagena (Bolívar) and from Bogotá DC, professional in International Business and disabled at the time of the consultation.

Regarding his peri-natal history, normal pregnancy, psychomotor and language development without alterations are reported. History of school development within normal limits. Regarding the pathological history, they report that on July 26, 2014, he was diagnosed with a primary grade IV primary neuroectodermal tumor in the central nervous system, which debuted with severe headache and behavioral disturbance (aggressiveness); behavioral changes started about a year ago with a tendency to irritability and verbal aggression. According to the above, he required surgical resection (07/30/2014), receiving further treatment with radiotherapy (28 sessions - ended in October 2014) and chemotherapy (25 sessions - ended in June of this). In relation to family history, neoplasia is reported in a maternal aunt.

At a cognitive level, after surgery, a steady course development was presented, characterized by a memory deficit for recent events, for example, he forgets conversations, events from previous days and even the same day, what he plans to do, appointments and dates, so he

## **Neuropsychological profile of an adult with major neurocognitive disorder secondary to a primitive neuroectodermal tumor of the central nervous system**

uses an agenda but still has to remember it; such symptomatology was exacerbated after chemotherapy. Additionally, bradypsychia, bradykinecia; omission of elements in the grammatical structure; frequent anomies in spontaneous language, so he uses omnibus words, circumlocutions and perphrases; slight difficulties in understanding (requires that he is spoken to more slowly to "process the information"); failures in attention maintenance, sometimes loses the thread of conversations and fails to do two things at the same time; he stopped writing because of tremors in his upper extremities; Regarding executive functions, difficulties were found in problem solving, decision making, planning and organization of behavior. In relation to mood and behavior, they mention emotional lability, irritability, low tolerance for frustration, sadness and easy crying, as well as visual hallucinations (he sees shadows); these alterations were intervened by clinical psychology; in his family nucleus, no process of coping and management of the pathology was initiated in the patient.

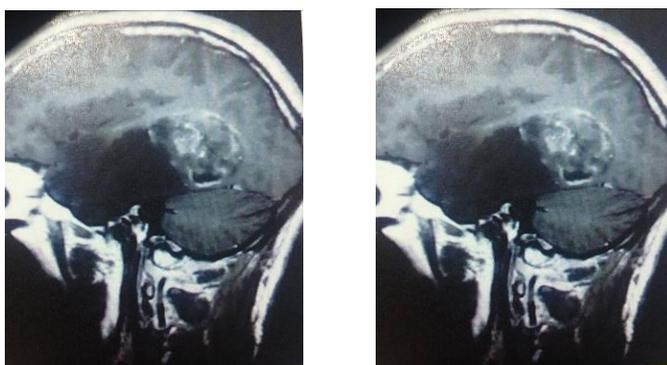
As for the basic activities of care, he requires help especially on the days when symptoms of vertigo occur; he feeds on its own and sometimes has difficulty controlling bladder sphincters; depends on others for the instrumental activities of daily life.

### ***Additional exams***

Magnetic Resonance with Contrast (08-2014): Temporary residual expansive lesion and left insular region.

Computed Axial Tomography - CT (12-2014): Findings related to area of residual parietooccipital encephalomalacia on the left side and ipsilateral craniotomy changes. No other alterations are identified (Image 1)

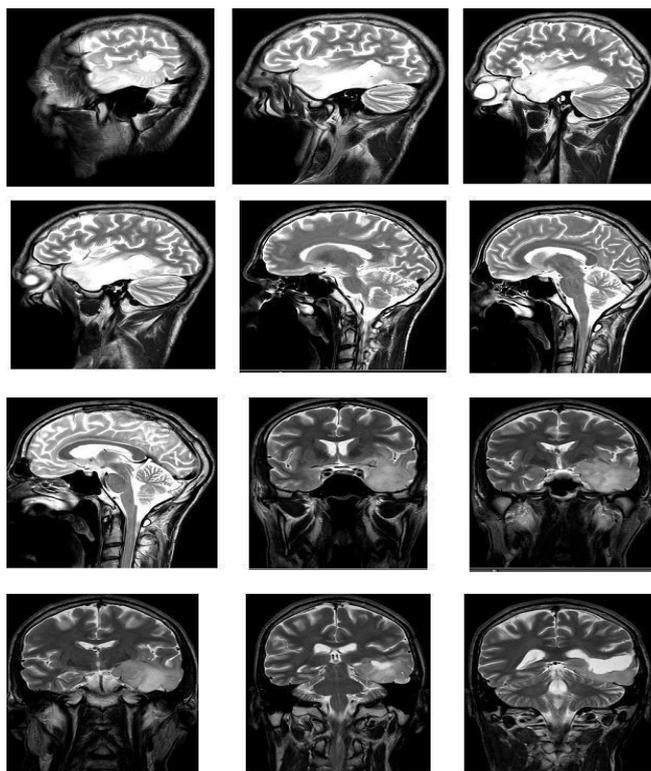
### ***Image 1. Computed Axial Tomography in coronal and sagittal section.***



Resonance Spectroscopy (23-01-2015): In the affected temporal lobe the spectrum obtained demonstrates an important cavity of the NAA peak, with a marked increase in the Cho peak and alteration of the Gho / Cr ratio that is 4.83 on the sick side and 1.10 on the healthy side. Increase in the ml peak and presence of lactate doublets in the affected region. The spectrum obtained in the right temporal lobe has normal characteristics. The results are compatible with loss of viable neurons, increased cell mitosis and presence of anaerobic metabolism, which suggests tumor activity (Image 2)

## Neuropsychological profile of an adult with major neurocognitive disorder secondary to a primitive neuroectodermal tumor of the central nervous system

*Image 2. Resonance Spectroscopy*



Magnetic Resonance (01-2015): Resection of the parenchymal lesion in the left temporal lobe, with formation of a postoperative cyst that communicates with the adjacent lateral ventricle; this cyst has thin walls and has two areas of abnormal enhancement after the administration of contrast material, which are located posteriorly and laterally, with an approximate diameter of 7.2 mm; The other lesion is located adjacent to the communication of the cyst with the lateral ventricle, with a subependymal, linear location of 10 mm. There is no evidence of other residual masses.

Simple brain scan (03-2015): Postoperative control, which shows expansive molding from the left temporal lobe in which we see a cavitation of liquid content and reaction of anterior and diffuse temporal diffuse hypodensity of the insula. There are no bleeding marks or extra axial compression collection.

### *Instruments*

Scale activities of daily living: Evaluate the basic (ABVD), instrumental (AIVD) and advanced (AAVD) activities of daily life secondary to cognitive problems. It consists of asking the informant a series of questions, making the necessary modifications. It is scored using the following scale: 0 = Normal (no problems); 1 = Do you ever have difficulties in the most complex things you did; Some isolated problem. 2 = Often (frequently) has difficulties, as it requires stimuli and supervision. 3 = Always has difficulties; Keep doing an activity, but do it poorly and require assistance. 4 = Totally unable (does not) perform the task. He has abandoned daily tasks due to mental problem. He has never done it; When a person has never done a specific task, the column “Has never done it” or “Not evaluable” will be marked (Peña-Casanova, 2012).

## **Neuropsychological profile of an adult with major neurocognitive disorder secondary to a primitive neuroectodermal tumor of the central nervous system**

Goldberg scale: It is an interview used as an instrument for screening anxiety and depression; It consists of two subscales one of anxiety and another of depression, with nine items each, all of them with dichotomous response. The scores obtained greater than or equal to 4 points in anxiety and greater than or equal to 3 in depression are significant (Goldberg, Bridges & Duncan-Jones, 1988).

Subjective complaint of memory and / or scale of memory disorders (QSM): Scale used to determine the status of episodic memory in relation to the subjective report of both the assessed person and their relatives or caregivers. It consists of 15 questions that will be scored on a 4-point Likert scale (0 = never; 1 = rarely; 2 = sometimes; 3 = almost always). A score greater than 19 evidences memory impairment. Discrepancies between patient and family scores allow anosognosia to be detected, specifically when the patient's score is lower than the family member's score (Vander Linden, Wijns, Von Frenkell, Coyette and Seron, 1989).

Abbreviated neuropsychological examination program Test Barcelona abbreviated (TB-A): Neuropsychometric instrument for clinical use, developed to quantitatively measure the general cognitive state, that is, it allows establishing the functional status of the most important neuropsychological areas (Peña-Casanova, 2004).

Young NEURONORMA Program (NN) (Peña-Casanova, Casals-Coll, Quintana, Sánchez-Benavides, Rognoni, Calvo, Palomo, Aranciva, Tamayo and Manero, 2012): Multicenter study developed with the objective of acquiring Spanish normative data in adults younger than 50 of widely used neuropsychological tests. It includes a battery of neuropsychological evaluation that is composed of a neuropsychological, neuropsychiatry and functional examination using various scales and neuropsychometric tests. The subtests applied were the following: Digits (Wechsler, 2004); Corsi cubes: (Wechsler, 2004); Trail Making Test (Forms A and B): (Reitan, 1992); Symbol Digit Modalities Test (SDMT): (Smith, 1973). Free and Cued Selective Reminding Test (FCSRT) (Buschke, 1984); Complex figure of Rey-Osterrieth (Copying and memory) (Rey, 1941); Tasks of animal semantic verbal fluency (Isaacs and Kennie, 1973) and phonemic letter P (Borkowski, Benton and Spreen, 1967). Tower of London-Drexel University (TOL-DX): (Culbertson and Zillmer, 2000); Boston Naming Abbreviated Test: (Kaplan, 2001).

BANFE II Neuropsychological Battery of Executive Functions (Flores Lázaro, Ostrosky-Solís and Lozano Gutiérrez, 2012): Instrument that groups an important number of neuropsychological tests of high reliability and validity for the evaluation of cognitive processes that depend mainly on the prefrontal cortex. These tests were selected and divided mainly based on the anatomical-functional criteria: those that evaluate complex functions that depend on the orbitofrontal cortex (COF), medial prefrontal cortex (CPFM), dorsolateral prefrontal cortex (CPFDL) and the anterior prefrontal cortex (CPFA). The application of the test is based on a quantitative and qualitative analysis of correct answers and errors.

TBDA Boston test for the diagnosis of Aphasia (Evaluation of Aphasia and related disorders 3rd Ed 2006, Goodglass): This instrument comprises three general objectives 1) Diagnose the presence and type of aphasic syndrome, its topography and underlying processes affected as well as strategies to compensate them; 2) Evaluate the level of performance over a wide range of tests, both for initial determination and for the detection of change over

**Neuropsychological profile of an adult with major neurocognitive disorder secondary to a primitive neuroectodermal tumor of the central nervous system**

time; 3) Overall evaluation of the difficulties and possibilities of the patient in all areas of language, as a guide for treatment. The extended version was applied and in accordance with the information obtained in the global assessment, specifically in language deficiencies, the following subtests were used: fluency, automatic language / conversation speech, narrative speech, listening comprehension, repetition, denomination, reading and writing.

**RESULTS**

During the evaluation, the patient was alert, collaborative and motivated during the neuropsychological evaluation sessions. There was a slowdown in processing speed during the execution of most tests. Table 1 shows the scores obtained in the behavioral and mood screening scales, described below.

**Table 1. Cognitive, functional, emotional and behavioral screening scores.**

Scale	Direct punctuation	Cut points	Classification
ADFASC	AIVD* : 21/27	>6.5	Intense Alteration
	ABVD*: 3/24		Mild Alteration
Goldberg Scale	Anxiety 9/9	>4	Meaningful
	Depression 8/9	>2	Meaningful
Memory Scale			
Patient	20/45	>19	Meaningful
Family	25/45	>19	Meaningful

**Behavioral and mood screening:** The results on the Goldberg anxiety and depression scale are significant for anxiety, the patient refers to irritability, apathy, easy crying and poor frustration tolerance. As for depression, he reports little energy and interest in things, isolation, difficulties in concentrating, falling asleep, lack of appetite and bradypsychia.

**Functional screening:** Significant alterations were found in advanced activities of daily life (AADL), he says that nothing motivates him to carry out social life or some type of activity outside the home for leisure and recreation. As for the instrumental activities of daily life (IADL) he does not successfully manage money, he gets confused in the amounts so he does not make purchases alone, his mother manages his medication, he prefers to always go accompanied, he also manifests difficulty to move in and out of the house

In the basic activities of daily life (BADL) he presents a moderate alteration, he requires help when climbing stairs for fear of losing his balance, he requires supervision especially in the days that it experiences vertigo. Regarding hygiene and personal arrangement, he sometimes presents difficulties in controlling bladder sphincters. He needs help from the caregiver to bathe, organize and select his clothes. His sleep patterns are altered by insomnia of conciliation. He also shows altered eating patterns with improvement tendency.

**Abbreviated Test Barcelona Neuropsychological Exploration Program (TB-A):**

**Orientation:** The results obtained by CD shows that he is oriented in person, time and space, as well as in right-left orientation. **Language (Understanding orders and complex verbal material):** Presents fluent language, formally correct, with adequate prosody, grammatical construction and articulation; with anomic-type blockages, circumlocutions and semantic and verbal parafasias. The understanding in conversational language of simple and semi-complex orders is adequate, however, the understanding of complex grammatical structures

## **Neuropsychological profile of an adult with major neurocognitive disorder secondary to a primitive neuroectodermal tumor of the central nervous system**

is altered. Ideomotor praxias (Symbolic gestures): CD presents adequate reproduction of symbolic gestures to order and imitation. Visuo-perceptive Capacity (Superimposed images): With respect to visual gnosis, it is observed that it is preserved allowing him to discriminate and recognize the drawings presented in a whole. Premotor functions: Preserved in the subtests reproduction of rhythms, motor sequences, graphic alternation and imitation of postures. Verbal abstraction: Alterations in simple abstraction of similarities and the abstraction of meanings that are implicit in a verbal messages (sayings).

**NEURONORMA youth program (NN):** Sustained visual attention (TMT-A, Corsi cubes): There is evidence of a slowdown in processing speed, as well as difficulties in visual tracking in the TMT-A test. Regarding the performance during the Corsi cubes test, the execution at the time of sequentially locating objects distributed in the space is consistent with his age and schooling, managing to place up to 8 elements directly. Sustained auditory attention (Digits): During the development of the task he shows good performance, since he maintains auditory attention during short periods of time managing to repeat up to 7 digits in direct order. Divided attention (SDMT): There is evidence of an alteration in the ability to divide focus and pay attention to two or more information channels. He manages to perform 34 elements in a minute and a half, which is below expectations given his age and educational level. Denomination by visual confrontation (BNT): During the test, he manages to name 29 of the 60 images presented, 13 of the others were evoked after the phonemic code, 3 he manifested not knowing them, 11 chosen correctly after multiple choice and 4 were not evoked after the election, although he claimed to know them. In addition, verbal parafasias (hunter by beaver and whipper by pin in Spanish), perphrases and a semantic parafasia (crow by pelican in Spanish) were evidenced. Such findings are compatible with an anomia picture, characterized by a deficit in lexical access (in the form of words). Constructive praxias (King Figure): In the proof of copy of the complete figure, he generates an identifiable copy with all the configurational elements and the majority of internal details, structured and organized in the space. However, slowing was evident during execution.

**Explicit verbal memory (FCSRT):** Over three essays and a set of 16 words, he generates an upward and productive learning curve (6,11,11), although with a volume of memory below the expected and benefiting of semantic keys (9,13,16) - although by volume of information he does not reach normality, in the last test provided he manages to recover all the elements. In a deferred way (at 30 minutes), his free memory (14) and password (15) scores are within normal range. Good performance after the key immediately and in a deferred way both spontaneously and with facilitation suggests that the processes of consolidation and evocation of verbal information are preserved. However, he presents flaws in learning strategies that interfere with the volume of coded information, these being part of the executive functions. Visual memory (King Figure Evocation): In the recovery task, it was found that of 36 elements of a previously copied figure and after a heterogeneous and homogeneous interference he evokes 16.5 elements, a result that falls below the expected for his age and schooling.

**Executive functions:** Working memory (Corsi Cubes - Inverse digits): During the Corsi Cubes test in reverse order, it is evidenced that the ability to store and process visual information temporarily is conserved, he manages to perform up to 7 regression movements. Regarding the inverse digits task, he repeats up to 5 digits in regressive order; evidencing that the phonological component of working memory is preserved. Alternate attention (TMT-B): There is evidence of an alteration in the ability to alternate between two pieces of

**Neuropsychological profile of an adult with major neurocognitive disorder secondary to a primitive neuroectodermal tumor of the central nervous system**

information simultaneously. No attention errors were recorded, however, he has slowed processing speed. Categorical evocation: Presents lower scores in semantic evocation (animals) and in phonemic (letter p), allowing to identify deficits to perform an active-executive search based on verbal cues. Sequential planning (Tower of London): Although the CD performance in total correct movements (8) and total movements (6) is within normality; deficit is evidenced in latency time (150 ') and in the total resolution time (362'). He manages to make the 10 models, plays 8 with the minimum of movements and commits 1 time violation (exceeds the minute). These findings, although they show that the patient manages to do sequential planning, put into action and solve a visual task, presents a marked slowdown.

**BANFE II:** Quantitative results are presented in Table 2, the scores between 1 and 6 of the standardized score, are below the expected for age and schooling indicating alteration, as suggested by the author of the test. Qualitative information according to the performance in each of the tests is detailed below.

**Table 2. BANFE Battery Punctuations**

Área	Sub test	Natural Score	Standardized score	Standardized rating
<b>Orbitomedial Area</b>	Labyrinth. Crossing (coded).	0	10	Normal
	Card game. Percentage of risk cards (coded).	34	10	Normal
	Card game. Total score (coded).	32	10	Normal
	Stroop "A" form. Stroop-type errors (coded).	<b>3</b>	<b>3</b>	<b>Altered</b>
	Stroop "A" form. Time (coded).	<b>236''</b>	<b>1</b>	<b>Altered</b>
	Stroop forma "A". Correct.	<b>74</b>	<b>1</b>	<b>Altered</b>
	Stroop "B" form. Stroop-type errors (coded).	0	12	Normal
	Stroop "B" form. Time (coded).	<b>183''</b>	<b>1</b>	<b>Altered</b>
	Stroop "B" form. Correct.	84	12	Normal
	Card classification. Maintenance errors (coded).	<b>2</b>	<b>1</b>	<b>Altered</b>
	<b>Prefrontal Anterior Area</b>	Semantic classification. Number of abstract categories (coded).	<b>2</b>	<b>6</b>
Selection of sayings. Time (coded).		<b>232''</b>	<b>1</b>	<b>Altered</b>

**Neuropsychological profile of an adult with major neurocognitive disorder secondary to a primitive neuroectodermal tumor of the central nervous system**

<b>Área</b>	<b>Sub test</b>	<b>Natural Score</b>	<b>Standardized score</b>	<b>Standardized rating</b>
	Selection of sayings. Correct. (Coded)	<b>2.5</b>	<b>3</b>	<b>Altered</b>
	Metamemory Negative errors (coded).	3	9	Normal
	Metamemory Positive errors (coded).	0	13	Normal
<b>Dorsolateral Area (Working Memory)</b>	Self-Directed Signaling Perseveration (coded).	2	10	Normal
	Self-Directed Signaling Time (coded).	<b>205''</b>	<b>1</b>	<b>Altered</b>
	Self-Directed Signaling. Correct	22	12	Normal
	Consecutive subtraction "B". 100-7. Time (coded).	88''	10	Normal
	Consecutive subtraction "B". 100-7. Correct	14	11	Normal
	Consecutive addition. Time (coded).	51''	10	Normal
	Consecutive addition. Correct	20	10	Normal
	Alphabetical ordering Trial # 1 (coded).	2	9	Normal
	Alphabetical ordering Trial # 2 (coded).	<b>0</b>	<b>1</b>	<b>Altered</b>
	Alphabetical ordering Trial # 3 (coded).	<b>0</b>	<b>1</b>	<b>Altered</b>
	Visuospatial working memory. Maximum sequence	3	12	Normal
	Visuospatial working memory. Perseverations (coded).	0	11	Normal
	Visospatial working memory. Order errors (coded).	<b>5</b>	<b>5</b>	<b>Altered</b>
	<b>Dorsolateral Area (Executive Functions)</b>	Labyrinths. Planning (no exit) (coded)	1	12
Labyrinths Time (coded).		37.4''	8	Normal
Card classification. Correct.		44	8	Normal

**Neuropsychological profile of an adult with major neurocognitive disorder secondary to a primitive neuroectodermal tumor of the central nervous system**

<b>Área</b>	<b>Sub test</b>	<b>Natural Score</b>	<b>Standardized score</b>	<b>Standardized rating</b>
	Card classification. Perseveration (coded).	5	10	Normal
	Card classification. Deferred perseveration (coded).	2	11	Normal
	Card classification. Time (coded).	<b>600''</b>	<b>3</b>	<b>Altered</b>
	Semantic classification. Total categories (coded).	<b>2</b>	<b>1</b>	<b>Altered</b>
	Semantic classification. Total average animals (coded).	21	19	Normal
	Semantic classification. Total score (coded).	<b>6</b>	<b>1</b>	<b>Altered</b>
	Verbal fluency. Correct (coded).	<b>13</b>	<b>5</b>	<b>Altered</b>
	Verbal fluency. Perseveration (coded).	2	7	Normal
	Tower of Hanoi 4 discs. Movement (coded).	15	14	Normal
	Tower of Hanoi 4 discs. Time (coded).	135''	8	Normal

***Orbitomedial Area***

Respect for limits and following rules (Labyrinths): The task shows an adequate capacity for motor control and visuospatial planning; he solves all the mazes without going through any of the walls; however, he touches the walls in three of them and in one he follows the path without exiting. Ability to determine risk-benefit relationships to obtain greater profit (Card game): During the test he detects and avoids risk and benefits selections, obtaining 34% of risk cards; He also identifies and maintains benefit selections with a total score of 32. Inhibitory control (Stroop form "A" and form "B"): The ability to inhibit highly automated responses and response selection based on the criteria required in the form "A" is altered, presents 10 errors and 74 hits. There is evidence of a slowdown in execution demanding more time than expected to complete the test. In the Stroop form "B" test, his performance was consistent with his age and schooling, he obtained the 84 possible hits without errors; however, the time taken is not the expected one to complete it. Additionally, he must cover the other words to be able to read the corresponding one.

***Previous Prefrontal Area***

Abstract attitude (semantic classification): In this task spontaneously produced 2 abstract categories presenting difficulty in accessing the requested information. Comprehension, comparison and selection of answers with figurative meaning (selection of sayings): During the task he has difficulties identifying the abstract meaning by comparing the possible alternatives of two sayings and the time used to perform the test is below normal parameters

## **Neuropsychological profile of an adult with major neurocognitive disorder secondary to a primitive neuroectodermal tumor of the central nervous system**

Metamemory process (Metamemory): With the development of the task it was possible to conclude that the monitoring capacity is preserved by making adjustments between performance judgments (4,5,5,5,5) and actual performance (4,5, 5,6,7), on which he presented two negative errors and none positive indicating that CD underestimated his learning.

### ***Dorsolateral Area (Working Memory)***

Self-directed visuospatial working memory (Self-directed signaling): By making 22 signals out of 25 possible it is inferred that he presents adequate development in action strategies; However, there is evidence of a slowdown in execution taking 205", which is below the expected level, presenting 3 omissions and 2 perseverations as pathological phenomena. Reverse Sequencing (Consecutive Subtraction "B"): In this task, he performs simple and complex consecutive and reverse mental operations. He manages to solve operations without errors and in the expected time. Consecutive sequencing (Consecutive sum): The ability to perform consecutive mental operations is preserved, achieving the task set in the expected time and without making mistakes. Verbal Working Memory (Alphabetical Ordering): In this test he has difficulties to maintain and mentally manipulate verbal material as the amount of information increases despite achieving it in one of the three lists.

Directed Visuospatial working memory: There is little capacity to retain and reproduce the sequential order of a series of figures. During the execution of the task, he states that he does not understand the instructions given in the first list, once they are repeated, he manages to perform the exercise in the second trial; however, in the second and third list he fails, presenting 3 errors of order, 1 perseveration and 6 intrusions.

### ***Dorsolateral Area (Executive Functions)***

Planning (Labyrinths): In this activity, it is evident that he systematically anticipates visuospatial behavior, performing the task in the expected time. However, on 1 occasion he remains on dead-end roads within the visuospatial route it carried. Mental flexibility (Card classification): Generates classification hypotheses (41 hits) and inhibits wrong answers avoiding repetitive uses (5 perseverations and 2 deferred perseverations); However, there is evidence of slowing in the execution, time is not the expected one to complete the test. Semantic classification: During the task, he shows difficulty in the ability to produce the largest number of semantic groups; In the course of 5 minutes he manages to make 2 categories with an average of 21 animals. Verbal Fluency: In this test, he shows low capacity to fluidly produce and in a limited time the greatest number of possible verbs; in one minute he manages to recover 13 verbs with 2 intrusions. Tower of Hanoi: In the activity he anticipates sequentially actions in both progressive and regressive order; he presents a total of 15 movements and an error in an expected period of time. This suggests that their ability to plan and put into action a novel task with visual component is preserved. Regarding the areas in general, the qualitative results are described below:

*Medial Orbit Area:* The patient has an adequate capacity to establish risk - benefit, control and motor planning relationships to reach a specific goal, as well as to respect limits (impulsiveness control). The inhibition of highly automated responses (Stroop form A) is altered, although the performance in form B was as expected for its age; in general in both tests slowdown is observed.

## **Neuropsychological profile of an adult with major neurocognitive disorder secondary to a primitive neuroectodermal tumor of the central nervous system**

*Anterior prefrontal area:* Results show a deficit in the capacity of abstraction through the generation of semantic categories, as well as to evaluate abstract meanings by comparing alternatives. However, in the metamemory test, he makes judgments and performs monitoring according to its age and schooling, as well as an effective control over the memory strategies it uses to solve the indicated tasks.

*Dorsolateral area working memory and executive functions:* It presents a deficit in the capacity for abstraction and initiative, as well as to keep information in the working memory and manipulate it mentally; there are also difficulties in selecting and producing efficiently and in a limited time the greatest amount of possible verbs. Also, the ability to perform simple calculation operations, sequence ordering and execution monitoring is preserved; generates and modifies classification criteria, develops effective strategies and plans a series of actions that only together and in sequence lead to a specific goal.

***TBDA Boston test for the diagnosis of Aphasia:*** Next, the results obtained in the language test applied to CD in its expanded version are described; At the end of the application and considering the state of exhaustion, effort and fatigue, it was necessary to apply the criteria of the abbreviated version as is the case of the tests that make up the writing component.

*Severity scale:* The CD score is within the normal range, since he can refer to different situations of daily life with little help. However, the reduction of speech, understanding and difficulty in accessing information, does not allow an appropriate thread to be managed.

*Fluency:* Fluent spontaneous language, he does not present difficulty at phonemic and syllabic level, the longest continuous uninterrupted emission of words is 6 obtaining a score within the average; he shows a variety of constructions and use of grammatical morphemes expected for their age and schooling, as well as adequate prosody.

*Automatic language / Speech conversation:* He answers all questions asked, indicating an adequate ability to communicate through courtesy social formulas, however, there is evidence of slowing in execution. The foregoing shows that in general, its automatic language is preserved and is one of its main forms of communication.

*Listening comprehension (Word discrimination):* It is difficult to understand semi-complex conversational language, as well as in the discrimination of words at the auditory level and the association with images; deficit is evident in the understanding of simple and semi-complex orders. During the development of the test there were interruptions because the passage of the leaves caused him discomfort (dizziness), slowing in the execution and the instruction had to be repeated several times

*Understanding words by categories:* Results show difficulties in understanding specific words of categories. The first three lists are applied each with ten items obtaining a score of 7, 9 and 10 in tools, food and animals respectively.

*Repetition:* Underlying syntactic abilities are preserved, as well as the auditory memory. He manages to repeat all the elements presented in words, meaningless words and sentences.

*Denomination:* Verbal verb denomination is altered in the denomination response subtest where CD provides 14 correct answers of 20 presented; In denomination by categories he

## **Neuropsychological profile of an adult with major neurocognitive disorder secondary to a primitive neuroectodermal tumor of the central nervous system**

obtains a score within the average in letters, numbers and colors. In the category II segment where the exploration with more complex elements is expanded, there is evidence of alteration in actions and tools, while in colors and animals their scores are within normality.

*Reading:* Reading capacity is preserved where selective dissociations are discarded; he allows to show ability in the symbolic recognition of letters and numbers. Achieve normal performance in subtests of matching types of writings and numbers, reading words and sentences aloud, understanding sentences and paragraphs aloud; Low performance is evidenced in the word drawing pairing subtest making two errors in a list of 10 items.

*Writing:* In general, CD performance is within the expected age and schooling, considering that the abbreviated version was applied in this segment due to the fatigue and exhaustion factor of the patient. Low scores in the subtests form, choice of letters and motor ease, are due to the fact that not all items were applied, due to the factors mentioned above; performance in the applied items is in accordance with their age and there is no evidence of any alteration or difficulty in carrying out the proposed tasks.

### **DISCUSSION**

TNEPs of the central nervous system are rare in adulthood and are classified within embryonic tumors, so their appearance and diagnosis are associated with childhood. According to Cortés et al. (2011) in the majority of patients, both children and adults, the clinical onset consists of hemiparesis, intracranial hypertension and seizures. However, in the present case it was found that the patient's tumor behavior was marked by slight behavioral changes with a tendency to irritability and verbal aggression during the year prior to diagnosis and debuted with severe headache.

The TNEP Generally, they are located in the frontal, temporal and parietal lobe, as it happened in the patient of the present case, who before the surgical resection, presented an important affectation of the left temporal lobe with loss of viable neurons, increase of mitosis Cellular and presence of anaerobic metabolism. According to the authors, Cortes, González and Revilla, (2011), the above is configured as a serious prognosis, due to early age, since in most cases reported in the literature the average age is 35.2 years in relation to the age of 25 of the patient in this case; as well as the necrosis and tumor dissemination that were evidenced in the neuroimaging provided prior to the evaluation.

During the global evaluation phase, the findings in the neuropsychological evaluation, the clinical observation, the information provided by the patient's family member and the neuroimaging findings, allowed to identify slowing in the processing speed, expressive language characterized by anomie (deficit in lexical access), circumlocutions and occasional semantic paraphasias, deficit in visual attention, both sustained and divided, in visual memory, in complex understanding and in some of the executive functions evaluated (learning strategies that interfere with the coding of information, alternating attention, categorical evocation and verbal abstraction). Conserving the self and alospsychic orientation, sustained auditory attention, expression and semi-complex understanding of the language, the constructive and ideomotor praxies, the visuospatial capacity, verbal mnesic processes of consolidation and evocation, and the rest of the executive functions evaluated. Based on the above, the mainly affected cognitive domains were evaluated in depth, with the purpose of testing or rejecting the working hypothesis raised at the beginning of the study, in which the possibility of a diagnosis of anomic aphasia was established, accompanied by a

## **Neuropsychological profile of an adult with major neurocognitive disorder secondary to a primitive neuroectodermal tumor of the central nervous system**

dysexecutive syndrome, considering in addition to the clinical characteristics, the location of the tumor. Thus, we proceeded to apply the Boston Test for the diagnosis of aphasia – TBDA- and the Battery of Executive Functions- BANFE-.

Regarding the results obtained from TBDA, it was found that the patient presented a deficit in auditory comprehension, word discrimination, as well as in the denomination verbal verb and visual confrontation. There is evidence of speech reduction, alteration of complex understanding and difficulty in accessing information (anomies). Spontaneous language is preserved, as well as reading, writing and repetition. The above is compatible with the definition given by Dieguez-Vide (2012), regarding anomia aphasia, which is characterized by fluent spontaneous language, with severe anomia which does not improve with facilitation; latencies occur in the search for the answer, circumlocutions, omnibus words, unfinished sentences, among others. An important aspect is related to the conservation of repetition, being a distinctive feature of extrasilvian aphasias, a region in which the patient's lesion of the present study is located, as well as that of the patient presented by Cortes et al. (2011), who after the second surgical resection and diagnosed with TNEP presented a motor aphasia, this being an extra-silvia aphasia.

On the other hand, considering the results obtained in the BANFE and in the tests that evaluate executive functions of the Neuronorma, there is a deficit in some of the frontal lobe functions evaluated such as: inhibitory control, verbal abstraction, verbal and visuospatial working memory. They are conserved, motor and sequential planning, reinforcement processing, metamemory and consecutive and inverse sequencing. In general, there is a deficit in the capacity for abstraction and initiative, as well as to maintain information in working memory and manipulate it in a mental way, presenting difficulties in generating learning strategies.

Hence, based on the statements made by Torralva and Manes, (2005) regarding the relationship of the fronto-subcortical circuits, especially the dorsolateral prefrontal circuit and the dysexecutive syndromes: “In the dorsolateral circuit there are projections towards the dorsolateral caudate nucleus, which also receives input from the posterior parietal cortex and the premotor area. This circuit is then connected to the dorsolateral portion of the pale globe and the crosslinked nigra substance and continues to the parvocellular region of the anterior thalamic nucleus. Injuries in this circuit produce deficits in a series of higher cognitive functions such as: planning, sequencing, flexibility, memory of spatial and verbal work, and self-awareness (metacognition), among others”.

Likewise, the dysexecutive syndromes after the appearance of a tumor, cause a picture of cognitive deficit and functional impairment that can be confused with the onset of dementia (Torralva & Manes, 2005). However, in the case of the patient in the present study, it was possible to show in its final stage of the disease a neurocognitive disorder secondary to neoplasia, characterized by temporal and spatial disorientation, attention deficit and in some of the frontal lobe functions evaluated, in addition to changes in behavior such as (apathy, emotional lability, irritability, easy crying); Table that interferes with the patient's functionality given the dependence on the AAVD, the AIVD and the ABVD.

In this sense, the effectiveness of the treatment, as in most cases found in the literature, does not show a correlation between survival and the degree of resection or chemotherapy (Páez and Archudia, 2011). García, (2013) states that after a resection, the sequelae of the disease

## Neuropsychological profile of an adult with major neurocognitive disorder secondary to a primitive neuroectodermal tumor of the central nervous system

and treatment are both physical and cognitive. In studies conducted with patients who suffered CNS tumors, a decrease in IQ, verbal and visuospatial skills, attention deficit, memory, psychomotor speed, executive functioning and learning was found.

Regarding rehabilitation, it is important to specify that the effectiveness of the treatment depends on the specific location of the tumor, its size and the speed of growth which will mark the course of the disease and the possibilities of intervention. In general, neuropsychological rehabilitation for patients with acquired brain damage and in this case due to TNEP, coincide in pointing out the joint use of three classic strategies (restoration, compensation and replacement) oriented not only to the improvement of cognitive functioning, but also to the most global and complex objective aimed at getting the subject to resume his daily activities in the most productive and satisfactory way possible (Noreña, Ríos-Lago, González, Sánchez, Garcia and Tirapu, 2010). The foregoing, considering that for the present case, a rehabilitation plan was established which was not carried out considering the accelerated growth of secondary tumors that were discovered after resection of the TNEP, radiotherapy and chemotherapy, requiring attention hospital and palliative medicine until his death.

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***Acknowledgements***

The author appreciates all those who participated in the study and helped to facilitate the research process.

***Conflict of Interest***

The author declared no conflict of interest.

**How to cite this article:** D M Rincón Barreto, L García Ortiz & C Martínez (2020). Neuropsychological profile of an adult with major neurocognitive disorder secondary to a primitive neuroectodermal tumor of the central nervous system. *International Journal of Indian Psychology*, 8(2), 66-86. DIP:18.01.010/20200802, DOI:10.25215/0802.010