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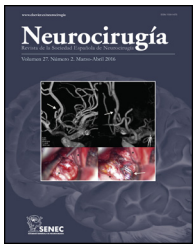

Case Report

Adolescents with vascular frontal lesion: A neuropsychological follow up case study

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ABSTRACT

The objective of this research was to identify clinically significant changes in cognitive functions in three adolescents who underwent surgery for resection of a focal vascular lesion in the frontal lobe. Cognitive functions, executive function, behavior regulation, emotion regulation, and social abilities were assessed prior to surgery, six and 24 months post-discharge. Significant clinical changes were observed during all the assessments. Cognitive changes after surgery are not homogeneous. Most of the significant clinical changes were improvements. Especially the significant clinical changes presented in EF domains were only improvements; these results suggest that EF were affected by the vascular lesion and benefitted by the surgery. After resection of a vascular lesion between 15 and 16 years of age the affected executive functions can continue the maturation process. Our results highlight the importance that assessments must include emotional aspects, even if deficits in these domains are not presented in the acute phase. Rehabilitation methods should promote the development of skills that help patients and their families to manage the emotional and behavioral changes that emerge once they are discharged from the hospital.

Adolescentes con lesión vascular frontal: seguimiento neuropsicológico de estudio de casos

Palabras clave:
Adolescentes
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RESUMEN

El objetivo de este estudio fue identificar cambios clínicamente significativos en las funciones cognoscitivas de tres adolescentes que fueron intervenidos quirúrgicamente para resección de una lesión vascular focal en el lóbulo frontal. Se midieron funciones cognoscitivas, funciones ejecutivas, regulación conductual, regulación emocional y habilidades sociales en tres momentos, antes de la cirugía, 6 y 24 meses después de la cirugía. Se

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observaron cambios clínicamente significativos durante los tres momentos de evaluación. Los cambios cognoscitivos después de la cirugía no son homogéneos. La mayoría de los cambios fueron incrementos. Especialmente los cambios clínicamente significativos presentados en funciones ejecutivas fueron mejoras, los resultados sugieren que la resección de una lesión vascular entre los 15 y 16 años de edad permite la recuperación de las funciones ejecutivas. Nuestros resultados señalan la importancia de incluir aspectos emocionales en la evaluación, aún si no se presentaron alteraciones emocionales en la fase aguda. Se sugiere que los métodos de rehabilitación apoyen a los pacientes y a sus familias a manejar los cambios emocionales y conductuales que surgen una vez que son dados de alta del hospital.

Introduction

The cognitive processes involved in the conscious control of thought and action are called executive functions (EF).[1] EF is a psychological construct composed of multiple interrelated cognitive functions such as anticipation and deployment of attention, impulse control, self-regulation, initiation of activity, working memory, mental flexibility, utilization of feedback, planning, organization and selection of problem solving strategies.[2] EF are essential to learn new skills, apply knowledge to real life situations, establish our autonomy from the environment and provide capacity for reflection.[3,4] These cognitive functions are largely mediated by the prefrontal cortex (PFC).[5] Research has tried to explain the relation between changes in the PFC and changes in EF observed during adolescence.[6–10] Some studies suggest that cognitive development observed during adolescence is related to gray matter pruning, while others observed that the increase of white matter provides better connectivity between cortical and subcortical regions, which underlie executive functions.[8–11]

Developmental studies show that during adolescence brain maturation is linked to efficiency on executive tasks. Cognitive flexibility matures between the 7 and the 10 years, earlier than planning and working memory.[2,12] At 12 years of age there is an improvement in goal directed behavior, between 14 and 17 years of age, adolescents improve their decision making, including affection, at 15 years of age there is an improvement in attention control and speed processing and between 16 and 19 years of age there are gains in working memory, planning and solution problems.[2] Cognitive functions are interrelated, speed of processing, inhibition and working memory develop in an independent way, but speed of processing and inhibition have a direct influence on the development of working memory.[13] EF have an important role in social abilities.[14] Social interactions require cognitive functions such as judgment, self-regulation, and organization of new information; problem solution and theory of mind.[14] The development of intact social skills depends on the maturation of brain, cognition (attention, executive skills, communication and social cognition) and behavior, within a supportive environmental context.[15]

The PFC myelination begins before birth and is completed during the third decade of life.[16] An acquired brain injury in the prefrontal cortex during adolescence may disrupt the maturation process of executive functions.[16–18] Brain injuries that can be detected during adolescence include vascular lesions, such as arteriovenous malformations (AVM) and cerebral cavernous angioma. AVM in children is a rare neurologic insult that occurs in less than 1% of children, “an AVM is an abnormal collection of blood vessels in which arterial blood flows directly into the draining vein without the normal interposed capillaries” (p.01).[19] The AVM draw blood away from normal vessels and the volume of blood directed to the AVM increases, as a consequence ischemia of the regions around the vascular lesion is presented, this is call the “blood steal phenomenon”. The treatment for AVM is the complete resection of the vascular lesion to prevent future hemorrhage and to preserve and restore neurologic function, while its success will depend on the location, size and hemodynamic properties of the AVM together with the clinical condition of the patient.[19] On the other hand, cavernous angiomas of the brain are rare.[20] The prevalence of cavernous angioma is of 0.4–0.5% in the general population, 8–15% of these cavernous are located in the brain and spinal cord.[21] A cavernous angioma is composed of irregular sinusoidal vascular structures without intervening nervous parenchyma, and there may be tiny vessels afferent, efferent and draining veins. Patients with cavernous angioma can be treated by administration of anticonvulsants or surgically, however, surgical intervention may have more benefits than medical interventions, in fact early surgical intervention provides more effective results.[22]

Study cases of cognitive outcomes of vascular lesions during childhood or adolescence report a strong relationship between the cognitive outcomes and the localization of the lesion and adjacent areas.[23–25] Whingham and Otoole Biddle[25] reported that regardless of the AVM location, participants presented with mild to moderate deficits in EF. Which has also been observed in children and adolescents with acquired brain injury who usually present deficits in EF.[26,27]

Age of onset is a factor to take in consideration for the cognitive outcomes of brain injuries, because some deficits emerge years later, when the social demands increase.[17] Longitudinal study cases of AVM in children showed that the cognitive outcomes change over time, while some cognitive functions improve, cognitive functions related to the localization of the lesion tend to deteriorate over time.[28,24]