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ORIGINAL ARTICLE

Analysis of activity and motor coordination in rats undergoing stereotactic surgery and implantation of a cannula into the dorsal hippocampus☆

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KEYWORDS
Stereotactic surgery;
Cannula placement;
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Abstract
Introduction: Stereotactic surgery is used to place electrodes or cannulas in the brain in order to study the function of several brain structures in preclinical research. The hippocampus has been extensively studied with this methodology due to its involvement in a wide range of neurological, cognitive, emotional, and affective disorders. However, the effects of stereotactic surgery on coordination and motor activity should be evaluated in order to determine whether this surgical procedure causes any neurological alterations that may bias the results of studies incorporating this technique.
Methods: We evaluated the effects of stereotactic surgery and implantation of a cannula into the hippocampus of female Wistar rats on the motor activity, forced swim, and rotarod tests. The stage of the oestrous cycle was included in the statistical analysis.
Results: Stereotactic surgery had no impact on any of the motor activity variables assessed in the open field (squares crossed, time spent in grooming, and rearing), forced swim (turning behaviour, lateral swimming, latency to first immobility, and time spent immobile), and rotarod (latency to fall) tests, compared with intact rats. Regardless of surgical manipulation, rats in the metestrus and diestrus stages crossed a greater number of squares and displayed longer immobility times than those in the proestrus and estrus stages.
Conclusion: Stereotactic surgery for cannula placement in the dorsal hippocampus does not affect coordination and motor activity in rats. We can therefore conclude that this procedure

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has no neurological complications that may interfere in the interpretation of results of studies applying this technique.

PALABRAS CLAVE
Cirugía estereotáxica;
Implante de cánula;
Hipocampo;
Coordinación motriz;
Actividad locomotora;
Microinyección

Análisis de la actividad y coordinación motora en ratas con cirugía estereotáxica e implante de cánula en el hipocampo dorsal

Resumen
Introducción: La cirugía estereotáxica permite el implante de electrodos o cánulas para estudiar el funcionamiento de diversas estructuras cerebrales a nivel preclínico. El hipocampo ha sido ampliamente estudiado con esta metodología, debido a su participación en desórdenes neurológicos, cognitivos, emocionales y afectivos. Sin embargo, el efecto *per se* de esta metodología sobre la coordinación y la actividad motora, para identificar o descartar alteraciones neurológicas que pudieran influir en los resultados de protocolos que la utilizan, requiere ser explorado.
Métodos: Se evaluó el efecto de la cirugía estereotáxica y el implante de cánula en el hipocampo de ratas hembra Wistar en las pruebas de actividad locomotora, nado y Rota-rod. El análisis estadístico consideró la fase del ciclo estral de las ratas.
Resultados: Ninguna de las variables evaluadas en las pruebas de actividad locomotora (cuadros cruzados, tiempo de acicalamiento y conducta vertical), nado (giros, nado lateral, latencia a la primera inmovilidad y tiempo de inmovilidad) o Rota-rod (latencia a la caída), fueron modificadas por la manipulación quirúrgica, en relación con ratas intactas. Independientemente de la manipulación quirúrgica, las ratas en metaestro-diestro cruzaron más cuadros y tuvieron mayor tiempo de inmovilidad, que las ratas en proestro-estro.
Conclusión: La cirugía estereotáxica y el implante de cánula en el hipocampo dorsal carecen de efectos sobre la coordinación y la actividad locomotora de la rata, por lo que se descarta algún daño neurológico que pudiera interferir en la interpretación de resultados en protocolos que incluyen esta manipulación experimental.

Introduction

Stereotactic surgery is a technique enabling brain structures to be located for electrode or cannula implantation, with the ultimate aim of exploring brain function.[1] These procedures have enabled the identification of neuroanatomical and neurochemical circuits involved in brain function and certain neurological disorders (epilepsy, movement disorders, and neurodegenerative diseases),[2–5] learning and memory impairment,[6,7] and emotional[8,9] and affective disorders.[10] Furthermore, stereotactic surgery is used to explore the therapeutic potential and action mechanisms of potentially effective substances for the treatment of the previously mentioned disorders in humans.[9,11–14]

The hippocampus is one of the most frequently studied brain structures due to its involvement in the neurobiology of multiple neurological, cognitive, emotional, and affective disorders. Intrahippocampal microinjection of such substances as kainic acid or pilocarpine[3,4] has been used to experimentally reproduce temporal lobe epilepsy, which is associated with a reduction in the number of neurons in the hippocampal CA1 region.[15] Under these experimental conditions, status epilepticus leads to memory and learning impairment,[16,17] which may be minimised by administering anticonvulsants.[14]

Other studies have explored the role of the hippocampus in neurological disorders associated with consumption of certain foods. Intrahippocampal microinjection of such neurotoxins as methylazoxymethanol, present in cycad seeds (*Dioon spinulosum*),[2] or linamarin, found in cassava root (*Manihot esculenta* Crantz),[18] promotes the loss of motor coordination and reduces the number of neurons in the hippocampal CA1 in rats.[18] These experimentally-induced alterations seem to be analogous to some of the neurological symptoms associated with consumption of cycad seeds or cassava root in humans (amyotrophic lateral sclerosis-parkinsonian dementia, tropical ataxic neuropathy, and konzo).[19–21]

Experimental models of locomotor impairment are used to evaluate the effects of intrahippocampal microinjection of neurotoxic compounds and substances that are potentially beneficial in humans (for example, as treatments for some neurological or psychiatric disorders).[2,11,14,15] However, very few studies have used specific tests to evaluate the intrinsic locomotory impact of stereotactic surgery. This study aimed to evaluate the effects of stereotactic