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Up-regulated microRNA-132 reduces the cognition-damaging effect of sevoflurane on Alzheimer's disease rats by inhibiting FOXA1

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Abstract

Objective

Some studies have implied the damaging effect of sevoflurane (sevo) on cognitive function in Alzheimer's disease (AD). This research was conducted to explore the effect of microRNA (miR)-132/forkhead-box A1 (FOXA1) axis on cognitive ability of sevo-treated AD rats.

Methods

The condensed-matter $A\beta_{1-40}$-induced AD rats were injected with miR-132- or FOXA1-related plasmids, followed by inhalation with 3% sevo. Then, the cognitive functions of AD rats were assessed. miR-132 and FOXA1 levels in hippocampal tissues of AD rats, and their interaction were identified.

Results

miR-132 expression was reduced and FOXA1 mRNA and protein levels were elevated in AD rats. miR-132 targeted FOXA1. Sevo treatment impaired cognitive function in AD rats. Elevated

miR-132 or inhibited FOXA1 attenuated sevo-mediated injury in AD rats. Overexpressed FOXA1 rescued the effect of elevated miR-132 in AD rats with sevo treatment.

Conclusion

Up-regulated miR-132 reduces the cognition-damaging effect of sevo on AD rats by inhibiting FOXA1.

Introduction

Alzheimer's disease (AD) is the most common cause of dementia in elderly people, and it accounts for 60–70% of all dementia. The incidence of dementia among people aged >65 years is 6.4%, in which AD accounts for 4.4% [1]. The increased level of cerebral β-Amyloid (Aβ) contributes to the neural inflammation and degeneration, eventually leading to dementia by a string of neurotoxic activities [2]. AD is currently diagnosed based on clinical performance with the combination of comprehensive evaluation, including magnetic resonance imaging and a neuropsychological examination scale. Nevertheless, the latency of AD generally takes 3 years or more from the appearance of symptoms to diagnosis [3]. Therefore, it is of great significance to seek for novel biomarkers to improve the diagnosis and treatment of AD, thereby repressing the development of the disease.

In recent decades, various microRNAs (miRNAs) have been illuminated and characterized in human diseases, and some miRNAs are implicated in the progression of AD, such as miR-146 [4], miR-107 [5] and miR-137/181c [6]. As a member of the miRNAs, abundant miR-132 is found in neurons of the mammals and dysregulated miR-132-3p is associated with neurodegenerative diseases [7]. Currently, the impacts of miR-132 on neuronal growth and synaptic functions are investigated [8]. Interestingly, the function mechanisms of miR-132 in AD have been revealed by some published studies [9,10], and miR-132 is suggested to relate to human longevity in AD [11]. Thus, it is a necessity to attain a thorough insight into miR-132-mediated AD progression. Forkhead-box A1 (FOXA1) functions as a pioneer transcription factor in the development of embryo and hepatic specification [12]. The effects of FOXA1 in human induced pluripotent stem cells-derived neuron have been identified in AD patients [13]. Except for that, it has been demonstrated that FOXA1 could regulate dopaminergic properties in ventral midbrain neurons [14], as well as functional integrity of the subthalamic nucleus [15]. Furthermore, sevoflurane (sevo), as a kind of anesthetic, has been studied to induce neurotoxicity in patients with AD [16]. Thus, it is essential to attenuate the neuronal injury that caused by sevo in AD patients. Based on the reports above, the effect of miR-132/FOXA1 axis on cognition function of AD rats treated with sevo was explored.

Section snippets

Ethics statement

Animal experiments were strictly treated in accordance with the Guide to the Management and Use of Laboratory Animals issued by the National Institutes of Health. The protocol of animal experiments was approved by the Institutional Animal Care and Use Committee of The Second Affiliated Hospital of Harbin Medical University....

Experimental animals

Ninety 8-week-old male Sprague Dawley (SD) rats (specific pathogen-free, 280–320 g) were provided by the experimental animal center of Harbin Medical University...

$A\beta_{1–40}$ injures the spatial learning and cognitive ability of rats

The spatial learning ability of rats was evaluated by Morris water maze test. In spatial probe test (Fig. 1A) and place navigation test (Fig. 1B), AD rats had extended EL from day 2 to 5 and decreased number of crossing the original platform. After sevo treatment, EL was further promoted and the number of crossing the original platform was decreased in AD rats. Pre-treatment with miR-132 mimic or si-FOXA1 caused shortened EL and elevated number of crossing the original platform in sevo-treated...

Discussion

Affecting millions of people, AD is a kind of neurodegenerative disorder, and the function mechanism as well as the impactful therapy remained to be clearly identified [22]. It has been unveiled that the miRNAs played a vital part in leading molecules in the RNA silencing [23]. This study was designed to unearth the function of miR-132 in AD by regulating FOXA1, and the experimental data highlighted that the elevation of miR-132 could ameliorate sevo-induced damage to AD rats by suppressing...

Authors' contributions

Yun Wu contributed to study design; Lin Cong contributed to manuscript editing; Yuena Cong and Nianping Feng contributed to experimental studies; Weiwei Liang contributed to data analysis....

Declaration of Competing Interest

The authors declare that they have no conflicts of interest....

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References (34)

L.L. Wang
The potential role of microRNA-146 in Alzheimer's disease: biomarker or therapeutic target?
Med. Hypotheses (2012)

C.A. Juzwik
microRNA dysregulation in neurodegenerative diseases: A systematic review
Prog. Neurobiol. (2019)

J.H. Taube
Foxa1 functions as a pioneer transcription factor at transposable elements to activate Afp during differentiation of embryonic stem cells
J. Biol. Chem. (2010)

G. Paxinos *et al.*
AChE-stained horizontal sections of the rat brain in stereotaxic coordinates
J. Neurosci. Methods (1980)

Z.X. Li
Effects of chitinase-3-like protein 1 on brain death-induced hepatocyte apoptosis via PAR2-JNK-caspase-3
Biochem. Biophys. Res. Commun. (2021)

S. Aakko
MYC-induced miR-203b-3p and miR-203a-3p control Bcl-xL expression and paclitaxel sensitivity in tumor cells
Transl. Oncol. (2019)

Y. Zhang
MicroRNA-132 attenuates neurobehavioral and neuropathological changes associated with intracerebral hemorrhage in mice
Neurochem. Int. (2017)

L. Song

A role for forkhead box A1 in acute lung injury
Inflammation (2009)

J. Zhang

MicroRNA-132 protects H9c2 cells against oxygen and glucose deprivation-evoked injury by targeting FOXO3A
J. Cell. Physiol. (2020)

Y.F. Ji

MicroRNA-132 attenuates LPS-induced inflammatory injury by targeting TRAF6 in neuronal cell line HT-22
J. Cell. Biochem. (2018)

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