Patients with major depressive disorder exhibit reduced reward size coding in the striatum

Masahiro Takamura, Yasumasa Okamoto, Go Okada, Shigeru Toki, Tetsuya Yamamoto, Naho Ichikawa, Asako Mori, Hideaki Minagawa, Yoshiyuki Takaishi, Yasutaka Fujii, Yoko Kaichi, Yuji Akiyama, Kazuo Awa, Shigeto Yamawaki

Department of Psychiatry and Neurosciences, Institute of Biomedical and Health Sciences, Hiroshima University, 1-2-3 Kasumi, Minami-ku, Hiroshima 734-8551, Japan

Daijikai Mihara Hospital, 6-31-1, Nakano-cho, Mihara, Hiroshima 723-0003, Japan

Graduate School of Integrated Arts and Sciences, Tokushima University, 1-1, Minamijosanjima-cho, Tokushima 770-8502, Japan

Hiroshima City Mental Health and Welfare Center, 11-27 Fujimu-cho, Naka-ku, Hiroshima, Hiroshima 730-0043, Japan

Department of Psychiatry, Yoshida General Hospital, Yoshida-cho Yoshida, Akiakata, Hiroshima 731-0595, Japan

Fujii Psychosomatic Clinic, 10-18, Teppo-cho, Naka-ku, Hiroshima, Hiroshima 730-0017, Japan

Department of Diagnostic Radiology, Institute of Biomedical and Health Sciences, Hiroshima University, 1-2-3 Kasumi, Minami-ku, Hiroshima 734-8551, Japan

Department of Clinical Radiology, Hiroshima University Hospital, Hiroshima University, 1-2-3 Kasumi, Minami-ku, Hiroshima 734-8551, Japan

ARTICLE INFO

Keywords:
Major depressive disorder
Anhedonia
Striatum
Monetary incentive delay task
fMRI

ABSTRACT

Background: Anhedonia is a core symptom of major depressive disorder (MDD). While recent evidence suggests that reduced motivation for reward may be a core feature of anhedonia, the abnormalities in modulatory neural responses to variable reward amounts in MDD patients remain unclear. We investigated whether MDD patients' ability to represent variable-sized monetary rewards in the striatum is disrupted.

Methods: Twelve MDD patients and 12 healthy volunteers completed an assessment of psychometric status and participated in a functional magnetic resonance imaging (fMRI) task that involved the anticipation of financial reward (monetary incentive delay task). The size of the monetary reward was varied among trial conditions and was cued with geometric stimuli. Patients participated in additional fMRI sessions after a 6-week pharmacological treatment with escitalopram, an SSRI.

Results: In healthy volunteers, striatal activity increased in proportion to the size of the monetary reward during reward anticipation. This pattern was altered in MDD patients, and significant group-by-reward size interaction effects were observed in the bilateral putamen and the left ventral striatum. Reward sensitivity in motor response and striatum activity at three regions were correlated in healthy controls. In MDD patients, this neurobehavioral coupling was not observed. In addition, changes in the neural reward sensitivity parameter at the left ventral striatum in response to treatment were positively correlated with a reduction of depressive symptoms.

Conclusions: Patients with MDD exhibit reduced ability to modulate neural response when adjusting for variable amount of reward. This result suggests that reward size coding in the striatum may represent a neural correlate of motivational anhedonia in MDD patients.

1. Introduction

Decline of motivation (anhedonia) is a core symptom of major depressive disorder (MDD). Although this symptom is known to be related to poor treatment outcomes for MDD (Spijker et al., 2001), first line antidepressants such as SSRIs have a limited treatment effect for anhedonia (Dunlop and Nemeroff, 2011). Thus, elucidating the neuro-pathology of anhedonia is important to develop an effective treatment method for major depression.

In recent years, the concept of anhedonia has been clarified, and it is proposed that 2 types of anhedonia, motivational and consummatory anhedonia, should be discriminated (Treadway and Zald, 2011; Whitton et al., 2015). Consummatory anhedonia represents a deficit in the experience of pleasure, and is considered a traditional conceptualization of anhedonia. However, recent reviews have suggested inconsistencies in observations concerning consummatory anhedonia in MDD (Treadway and Zald, 2011; Whitton et al., 2015). Motivational anhedonia in MDD is characterized by an inability to modulate...
behavior in response to intermittent rewards (Whitton et al., 2015), and there is growing evidence of the existence of motivational anhedonia in MDD patients. Previous behavioral studies showed that healthy people exhibit a biased response for a large reward relative to a small reward during a probabilistic reward task (Pizzagalli et al., 2005), while MDD patients exhibit a reduced biased response (Pizzagalli et al., 2008). Treadway et al. (2012) also reported a disrupted modulation of effort for large reward in MDD patients. In addition, motivational reward processing has been investigated extensively in animal studies, and evidence suggests that motivational reward processing is strongly related to dopamine (DA) system function (Treadway and Zald, 2011). Thus, investigating the disrupted motivational reward processing of MDD patients is a promising approach to clarify the neuropathology of anhedonia in MDD.

Previously, an fMRI study using a monetary incentive task demonstrated proportional activation of the striatum in humans anticipating increasing financial gain in healthy individuals (Knutson et al., 2001). A meta-analysis (Bartra et al., 2013) examined the neural correlates of subjective value, and supported the relationship between ventral striatum activity and subjective reward representation. If coding of reward becomes inaccurate, maladaptive behavior, such as a destructive reward learning, may occur. A previous study (Vrieze et al., 2013) reported that MDD patients showed reduced reward learning, and that this impairment predicts poor treatment response. However, to our knowledge, previous clinical neuroimaging studies of MDD have not investigated or detected maladaptive neural responses to variable amounts of monetary rewards. Some studies examined abnormal brain activity during anticipating reward in MDD patients using similar tasks as that of Knutson et al. (2001), but those studies did not demonstrate or directly examine de...
دریافت فوری
متن کامل مقاله

امکان دانلود نسخه تمام متن مقالات انگلیسی
امکان دانلود نسخه ترجمه شده مقالات
پذیرش سفارش ترجمه تخصصی
امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
امکان دانلود رایگان ۲ صفحه اول هر مقاله
امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
دانلود فوری مقاله پس از پرداخت آنلاین
پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات