The relation between glutamate and GABA abnormalities in the dACC and impulsivity in smokers and controls: Preliminary results

Mieke H. J. ter Mors-Schulte1,2, Anna E. Goudriaan2, Wim van den Brink2, Reinout W. Wiers3, Lianne Schmaal2,3

1 Addiction, Development, and Psychopathology Lab (Adapt Lab), Department of Psychology, University of Amsterdam, The Netherlands
2 Amsterdam Institute for Addiction Research (AIAR), Department of Psychiatry, Academic Medical Center, University of Amsterdam
3 Department of Psychiatry, VU University medical center, Amsterdam, The Netherlands

Introduction

There is increasing evidence that glutamate and GABA play an important role in the development and persistence of addiction possibly through their relationship with impulsivity traits (Schmaal et al., 2012). Glutamate and GABA abnormalities in the dACC have been reported for dependence to several substances, including smoking, using in vivo proton magnetic resonance spectroscopy (1H-MRS), but the relationship between these 1H-MRS findings and impulsivity traits is unknown.

Purpose of this study:
- To investigate whether smoking individuals differ in glutamate and GABA concentrations in the dorsal anterior cingulate cortex (dACC); and
- To study the relationship of dACC glutamate and GABA concentrations with impulsivity traits.

Preliminary results

Glutamate
- Trend towards group difference in glutamate, $F(1, 40) = 3.49, p = 0.069$, with smokers having a higher concentration compared to healthy controls [Fig 1]
- In smokers, glutamate concentration neg. correlated with BAS reward responsiveness scale ($r = -0.392, p = 0.012$). [Fig 2] This correlation was absent in healthy controls.

GABA
- Trend towards group difference in GABA ($F(1, 34) = 3.54, p = 0.069$) with smokers having a higher concentration compared to healthy controls [Fig 1]
- In smokers, GABA concentration neg. correlated with BAS drive ($r = -0.506, p = 0.019$) [Fig 3] and BAS reward responsiveness ($r = -0.660, p = 0.001$) [Fig 4]. These correlations were absent in healthy controls.

Conclusions

- There is a trend towards a group difference in glutamate and GABA; the direction of the differences is consistent with previous studies.
- No associations between increased glutamate/GABA concentrations and self-reported impulsivity. A possible explanation is the relatively low level of and low variation in impulsivity in the smokers.
- Smokers with higher glutamate and GABA concentrations showed lower scores on the BAS reward responsiveness scale, and smokers with higher GABA concentration showed lower scores on the BAS drive scale, suggesting that neurotransmitter concentrations in the dorsal Anterior Cingulate Cortex are neurobiological markers of motivational sensitivity.
- Normalizing glutamate dACC concentrations with pharmacotherapy such as N-acetylcysteine (Schmaal et al., 2012) or acamprosate (Umhau et al., 2010) could be an important target to support smoking cessation.
- Because the current preliminary data are derived from an ongoing study, we cannot draw final conclusions.

References


