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Expression of the transcription factor GATA3 in the postnatal mouse central nervous system

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Abstract

GATA binding protein 3 (GATA3) is an important regulator of central nervous system (CNS) development, but its expression pattern in the postnatal CNS has not been studied. In the present study, we examined the distribution of GATA3 mRNA in the mouse CNS at different postnatal stages by *in situ* hybridization. During the first 2 weeks of postnatal development, numerous GATA3-expressing cells were found in the intergeniculate leaf, ventral lateral geniculate nucleus, pretectal nucleus, nucleus of the posterior commissure, superior colliculus, inferior colliculus, periaqueductal grey, substantia nigra and raphe nuclei. Few notable changes in the profile of GATA3 expression occurred over this time period. As postnatal development progressed, however, GATA3 expression weakened, and was maintained in only a few regions of the adult CNS. Throughout the brain, we found that GATA3-expressing cells were NeuN-positive, and no colocalization with glial fibrillary acidic protein (GFAP) was observed. In the substantia nigra, GATA3 was exclusively expressed in cells of the reticulate part and some of which were found to be GABAergic. This study presents a comprehensive overview of GATA3 expression in the CNS throughout postnatal life, and the dynamics that we observed provide insights for further investigations of the roles of GATA3 in postnatal development and the maintenance of the mature CNS.

Keywords: GATA3; *In situ* hybridization; Brain; Postnatal development; Mouse

Abbreviations: 3V, third ventricle; 4V, fourth ventricle; APT, anterior pretectal nucleus; Aq, aqueduct; Cb, cerebellum; Cx, cerebral cortex; CNS, central nervous system; Co, cochlear nucleus; DT, dorsal tegmental nucleus; DLG, dorsal lateral geniculate nucleus; DpMe, deep mesencephalic reticular formation; DR, dorsal raphe nucleus; GAD67, glutamic acid decarboxylase 67; GATA3, GATA binding protein 3; GFAP, glial fibrillary acidic protein; Hi, hippocampus; Hy, hypothalamus; IC, inferior colliculus; IGL, intergeniculate leaf; DT, dorsal tegmental nucleus; LL, nucleus of the lateral lemniscus; IP, interpeduncular nucleus; MG, medial geniculate nucleus; MnR, median raphe nucleus; Mo5, motor nucleus of the trigeminal nerve; PAG, periaqueductal grey; pc, posterior commissure; PC, nucleus of the posterior commissure; PB, parabrachial nucleus; Pn, pontine nucleus; Po, posterior thalamic nucleus; Pr5, principal sensory trigeminal nucleus; py, pyramidal tract; R, red nucleus; RLi, rostral linear raphe nucleus; RMg, raphe magnus nucleus; RPa, raphe pallidus nucleus; RPF, retroparafascicular nucleus; SC, superior colliculus; SN, substantia nigra; SNC, substantia nigra pars compacta; SNR, substantia nigra pars reticulate; SpO, oral subnucleus of the spinal trigeminal nucleus; SPO, superior paraolivary nucleus; TH, tyrosine hydroxylase; VLG, ventral lateral geniculate nucleus; VPM, ventral posteromedial thalamic nucleus; Tph2, tryptophan hydroxylase 2; VTA, ventral tegmental area; ZI, zona incerta.

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1. Introduction

The GATA family transcription factors play critical roles in development, including cell-fate specification, cell proliferation and differentiation in various tissues (Simon, 1995; Patient and McGhee, 2002). The six members are divided into two subfamilies on the basis of sequence homology: GATA1-3 and GATA4-6 (Simon, 1995; Patient and McGhee, 2002). GATA1-3 are primarily expressed in the haematopoietic stem cells where they regulate gene expression in differentiating T-lymphocytes, erythroid cells and megakaryocytes (Pevny et al., 1991; Tsai et al., 1994; Pandolfi et al., 1995; Maeno et al., 1996). GATA4-6 are expressed in various mesoderm- and endoderm-derived tissues, such as heart, liver and gut, and are involved in the differentiation of the heart and viscerae (Laverriere et al., 1994; Kuo et al., 1997). Among the GATA factors, only GATA2 and GATA3 are expressed in the CNS, in partially overlapping patterns, from early embryonic stages (Maeno et al., 1996; Nardelli et al., 1999; Pata et al., 1999; Murphy and Reiner, 2002).

During embryonic development, GATA3 is necessary for the differentiation of caudal serotonergic neurons in the brainstem and for the development of rhombomere 4 (Hikke van Doorninck et al., 1999; Pata et al., 1999). Following these early stages, however, the expression and functions of GATA3 in the brain have yet to be studied. To begin

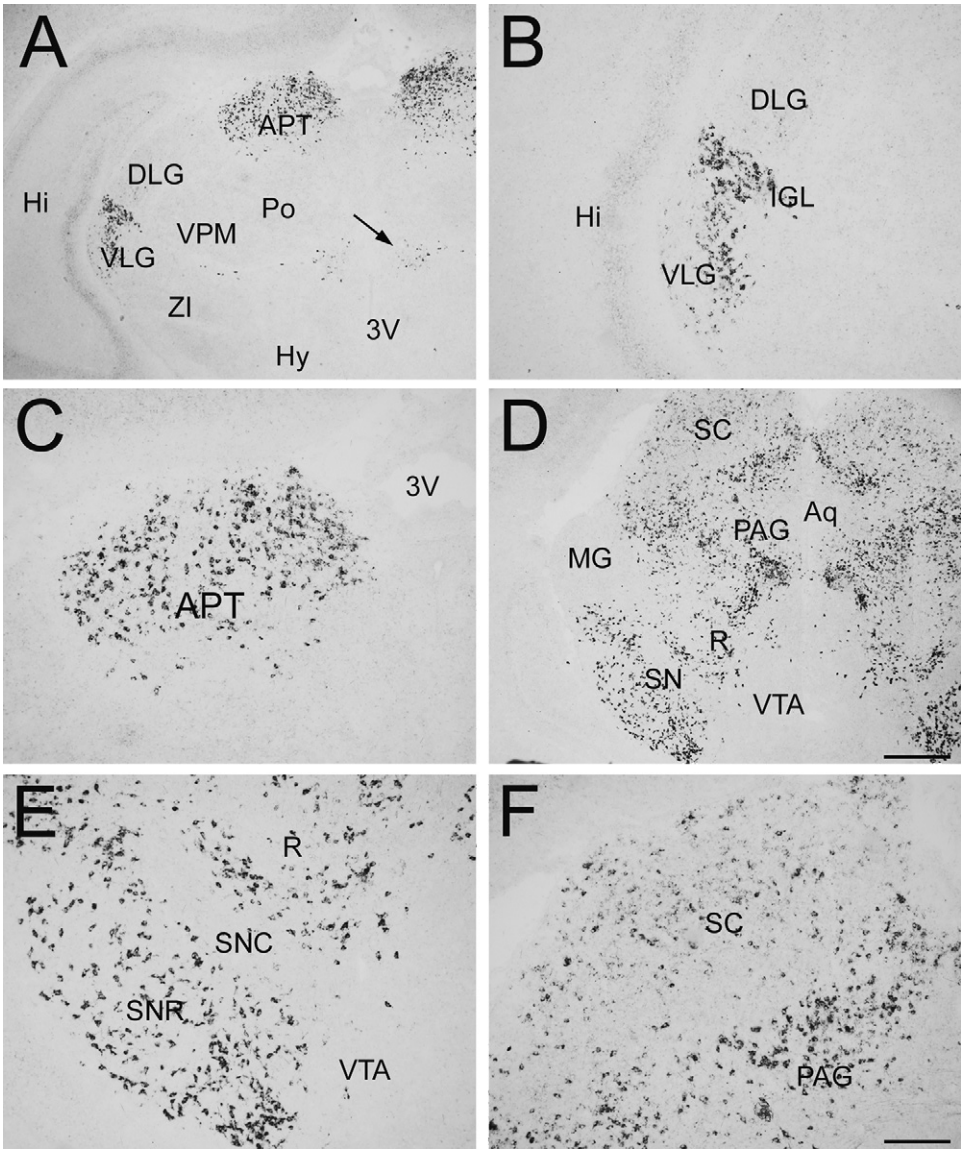

Fig. 1. Expression of GATA3 in the pretectal region and midbrain at P7. (A–C) At the level of the posterior commissure (pc), numerous GATA3-expressing cells are present in the intergeniculate leaf (IGL), ventral lateral geniculate nucleus (VLG) and anterior pretectal nucleus (APT), but not in the dorsal lateral geniculate nucleus (DLG) or posterior thalamic nucleus (Po). Arrowhead in (A) points to a cluster of GATA3-expressing cells in the dorsomedial hypothalamus. (B) and (C) show higher magnification of (A). (D–F) At the level of the superior colliculus, many GATA3-expressing cells are observed in the superior colliculus (SC), periaqueductal grey (PAG), red nucleus (R) and reticulate part of substantia nigra (SNR), but not the compact part of the substantia nigra (SNC), ventral tegmental area (VTA) or medial geniculate nucleus (MG). (E) and (F) show higher magnification of (D). 3V, third ventricle; Aq, aqueduct; Hi, hippocampus; Hy, hypothalamus; ZI, zona incerta. Scale bars: in D, 500 μm (applies also to A); in F, 200 μm (applies also to B, C, E, F).