Tissue and Cell 48 (2016) 283–296

Contents lists available at ScienceDirect

Tissue and Cell

journal homepage: www.elsevier.com/locate/tice

Histological study on the protective role of vitamin B complex on the cerebellum of diabetic rat

Sohair A. Eltony

Histology Department, Faculty of Medicine, Assiut University, Egypt

ARTICLE INFO

Article history:
Received 30 December 2015
Received in revised form 21 June 2016
Accepted 21 June 2016
Available online 23 June 2016

Keywords:
Diabetic encephalopathy
Vitamin B complex
Gliosis

ABSTRACT

Background: Disorder in cerebellar structure was reported in diabetes mellitus. B vitamins are involved in many significant metabolic processes within the brain.
Aim of the work: To detect the protective role of vitamin B complex on the histological structure of the cerebellum of experimentally induced diabetic rat.
Material & methods: Eighteen adult male *Wistar* rats were divided into two groups. Group I: normal vehicle control (n = 6). Group II: streptozotocin-induced diabetic rats (n = 12), which was equally divided into two subgroups; IIA (diabetic vehicle control), IIB (diabetic vitamin B complex-treated): streptozotocin-induced diabetic rats treated with vitamin B complex (1 mg/kg/day) for 6 weeks. Specimens from the cerebellum were processed for light and electron microscopy.
Results: In vitamin B complex treated group, the histological changes in Purkinje cells, astrocytes and oligodendrocytes were improved compared with the diabetic non-treated group. The white matter revealed intact myelinated axons. Inducible nitric oxide synthase (iNOS) and caspase-3 expression reduced. Glial fibrillary acidic protein (GFAP) expression revealed less activated astroglia. The number of Purkinje cells/mm^2 significantly increased. While, the number of GFAP positive astrocytes/mm^2 significantly decreased. In addition, the blood glucose level was reduced.
Conclusion: Vitamin B complex protected the cerebellum from the histological changes which occurred in STZ- induced diabetic rats.

1. Introduction

Diabetes mellitus is one of the most common serious metabolic disorders characterized by hyperglycemia, altered metabolism of lipids, carbohydrates and proteins that leads to oxidative stress and cell death in the brain, causing a state of dysfunctions in cognition and behavior (Lebed et al., 2008). Diabetes mellitus is associated with peripheral neuropathy and dysfunctions of the central nervous system in both human and animal models of the disease (Biessels et al., 2002). Evidence for brain disturbances were reported in hypothalamus, cerebral cortex, hippocampus and cerebellum of streptozotocin (STZ)-induced diabetic rats (Jackson-Guilford et al., 2000; Allen et al., 2004). Diabetic patients are prone to moderate alterations in memory and cognitive functions (Schoenle et al., 2002; Hernández-Fonseca et al., 2009), poor motor coordination and reduced motor activity (Daneman, 2001; Cox et al., 2005; Petrofsky et al., 2005). Diabetes is also associated with gradually developing end-organ damage in the central nervous system "diabetic encephalopathy" (Brands et al., 2003).

The cerebellum has long been recognized as the primary center of motor coordination in the central nervous system (Gardoni et al., 2002; Ahmadpour and Haghir, 2011). Recent studies in humans have also implicated cerebellum in cognitive processing and sensory discrimination in medical conditions as diverse as pervasive developmental disorders, autism, and cerebellar vascular injuries (Arroba et al., 2005; Anitha et al., 2006). Disorder and disagreement in cerebellar structure was reported in type 1 diabetes mellitus (Arroba et al., 2005). Also, Hernández-Fonseca et al. (2009) study has shown that STZ induced diabetes increased apoptosis in pyramidal neurons in cortex and cerebellar Purkinje cells in adult rats.

Vitamin B complex consists of thiamine (B_1), riboflavin (B_2), niacin (B_3), pantothenic acid (B_5), pyridoxine (B_6), biotin (B7), folic acid (B_9), and cobalamin (B_{12}) (Hompson, 2005; Bourre, 2006). It is possible to identify broad cognitive effects of certain B vitamins, as they are involved in many significant metabolic processes within the brain (Hompson, 2005). The role of Vitamin B complex in preventing neuronal death has been investigated (Lin et al., 2004). Thiamine supplementation can lead to improvement of the symp-

E-mail address: sohair_eltony@yahoo.com

http://dx.doi.org/10.1016/j.tice.2016.06.009
0040-8166/

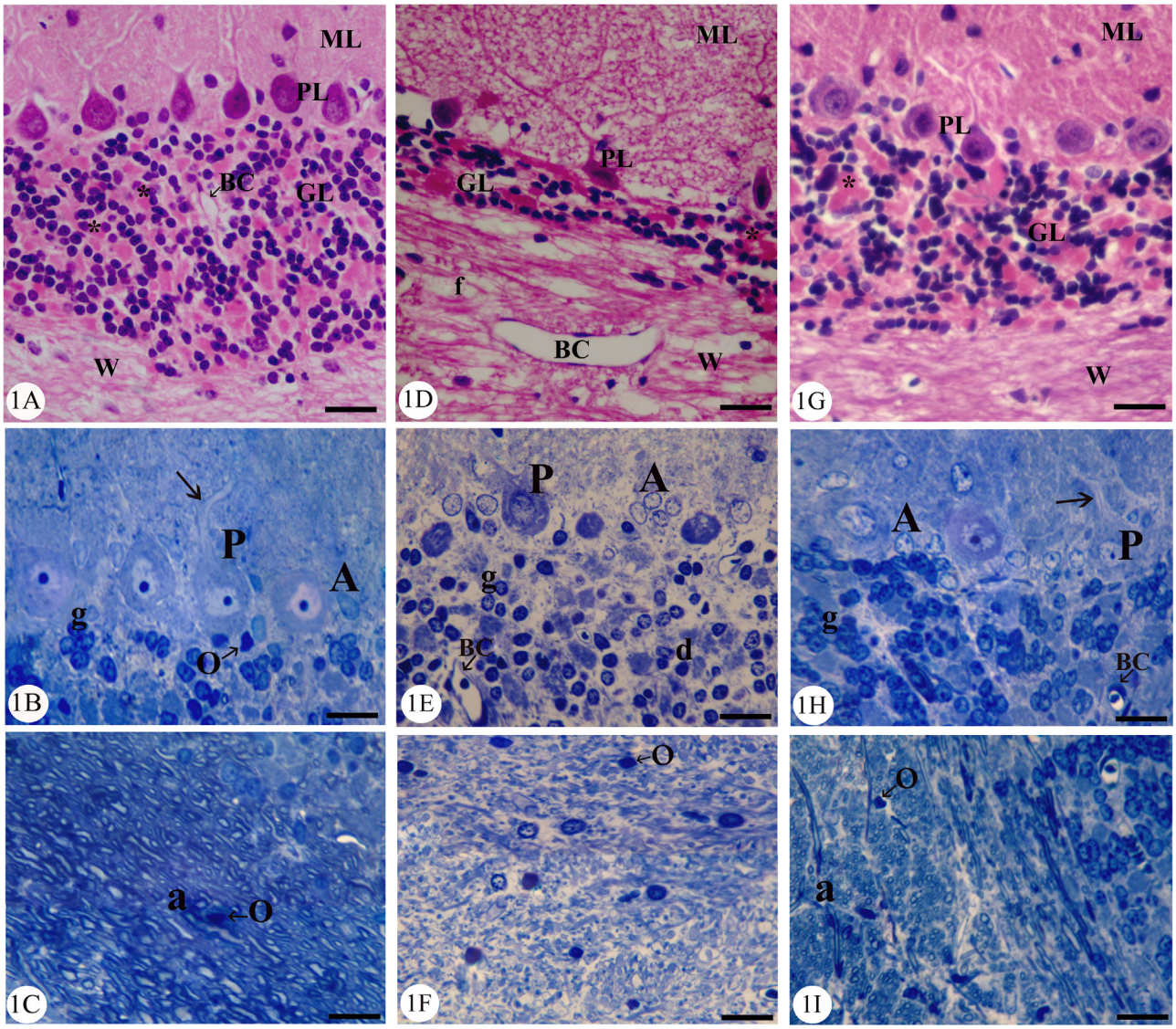
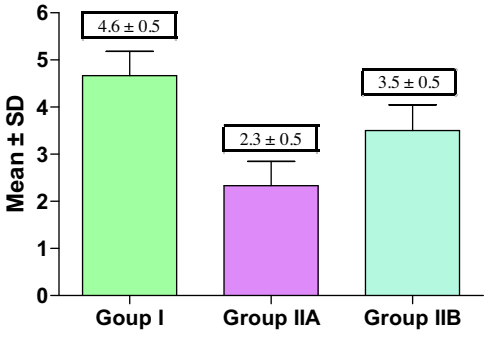


Fig. 1. Photomicrographs, **group I (A–C), group IIA (D–F), group IIB (G–I)**. Paraffin sections stained with hematoxylin-eosin, Scale bar = 25 μm (A,D,G); showing the three layers of the cerebellar cortex from outside to inside; molecular layer (ML), Purkinje cell layer (PL), granule cell layer (GL), cerebellar glomeruli (*), degenerated nerve fibers (f), blood capillary (BC), white matter (W).
Semithin sections of the cerebellar cortex gray matter (B,E,H) and cerebellar white matter (C,F,I) stained with toluidine blue, Scale bar = 10 μm; showing Purkinje cell (P) with extending apical dendrite (↑), Bergmann astrocyte (A), granule cells (g), oligodendrocyte (O), dark cells (d), myelinated axons (a), blood capillary (BC).

toms and often complete resolution of Wernicke's encephalopathy (a triad of ophthalmoplegia, ataxia, and confusion) (Galvin et al., 2010; Sullivan and Fama, 2012). Additionally, folic acid has also been found to improve the memory of older people (Reynolds 2002; Berry et al., 2007). Pyridoxine is involved in the process of making serotonin and norepinephrine, which are chemicals that transmit signals in the brain. It is also involved in the formation of myelin. Cobalamin plays vital role in the metabolism of fatty acids essential for the maintenance of nerve myelin (Sun et al., 2005).

So, this study aimed to detect the protective role of vitamin B complex on the histological structure of the cerebellum of experimentally induced diabetic rat.



Histogram 1. The mean number of Purkinje cells/mm^2 in the studied groups.
Group I vs Group IIA ($P < 0.001$).
Group I vs Group IIB ($P < 0.001$).
Group IIA vs Group IIB ($P < 0.01$)

2. Material and methods

A total number of 18 adult (5 month old) male *Wistar* rats (200 g body weight) were used in this study. They were purchased from Central Animal House, Faculty of Medicine, Assiut University. All animal procedures were in accordance with the standards set forth in guidelines for the care and use of experimental animals by Committee for Purpose of Supervision of Experiments on Animals