Intraocular pressure responses to systemic autonomic stimulation in diabetes mellitus

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Summary. The acute changes in intraocular pressure during sustained handgrip contraction (2.5 minutes duration) and the Valsalva manoeuvre (15 seconds duration), both standard tests of autonomic nerve function were studied in 14 diabetic patients and 14 similar aged control subjects.

During sustained handgrip contraction, diastolic blood pressure increased by 16.35 ± 1.87 mmHg in the diabetic patients and 21.36 ± 0.66 mmHg for the control group. Mean intraocular pressure decreased by 0.71 ± 0.43 mmHg in the diabetics, p < 0.05 and 0.64 ± 0.27 mmHg, p < 0.01 in the control group.

There was no correlation between the blood pressure and the intraocular pressure responses in either group.

On release of handgrip contraction, mean recovery intraocular pressure over 5 minutes was significantly lower than mean baseline values for the two groups; control: baseline 14.78 ± 0.49 to 14.14 ± 0.67, p < 0.001 and diabetic: 14.57 ± 0.65 to 13.86 ± 0.72, p < 0.001.

During the Valsalva manoeuvre, there was a significant rise in intraocular pressure in the control (+7.85 ± 0.75 mmHg, p < 0.001) and the diabetic group (+7.93 ± 1.18 mmHg, p < 0.001). 5 minutes after release of intrathoracic pressure, mean recovery intraocular pressure remained significantly below baseline values for the two groups. The Valsalva ratios were in the normal range for the control group (1.21 to 2.2) while 2 diabetics had abnormal ratios.

Introduction

An association between diabetes mellitus and glaucoma (both chronic open angle glaucoma and ocular hypertension), has been recognised for many years, although the exact nature of the relationship has not been fully defined. Increased prevalence of diabetes has been demonstrated in open angle glaucoma [1,2] ocular hyper tension [3,4] and closed angle glaucoma [4].
Diabetes is the commonest cause of autonomic neuropathy in the United Kingdom, and it has been suggested that anterior segment autonomic dysfunction may be a significant predisposing factor in the pathogenesis of raised intraocular pressure.

The acute intraocular pressure responses to systemic autonomic stimulation have been established in normal subjects (awaiting publication), using two standardized tests of autonomic nerve function:

1. Sustained handgrip as a test of sympathetic nerve function [6]. The cardiovascular responses to the sustained handgrip are reflex in nature [6] and are thought to be initiated by stimuli from the exercising muscle [7]. The rise in blood pressure is mediated partly by a heart-rate dependent increase in cardiac output [8] and partly by peripheral vasoconstriction mediated through alpha adrenergic receptors of the peripheral autonomic nervous system [9]. A rise of $\leq 10$ mmHg diastolic blood pressure is an abnormal response, $>16$ mmHg normal and borderline if between 10–16 mmHg [10].

2. Valsalva manoeuvre as a test of parasympathetic nerve function [11]. The cardiovascular responses during the Valsalva manoeuvre are well established. There are four phases to the haemodynamic responses to the Valsalva manoeuvre. Phase 1 is the onset of expiratory straining when the heart rate slows; it speeds up in response to the decreased venous return and falling blood pressure (Phase 2). Acute release of intrathoracic pressure (Phase 3) causes an increasing tachycardia due to a further drop in cardiac output secondary to increased pulmonary venous capacitance. Phase 4 (recovery period) follows with a reflex bradycardia as blood pressure increases secondary to increasing cardiac output into a peripheral vasoconstricted vasculature. The change in heart rate during the Valsalva was used as an index of response and expressed as the Valsalva ratio. This is the ratio of the longest R-R interval in the electrocardiogram after the Valsalva to the shortest R-R interval during the Valsalva. A ratio of $\leq 1.20$ is defined as abnormal and normal if $>1.21$ [10].

The aim of the present study was to examine the effect of diabetes mellitus on aqueous dynamics by measuring the intraocular pressure responses to equivalent systemic autonomic stimuli in a comparable group of patients with diabetes.