Effects of an animal model of vascular cognitive impairment in conjunction with a cafeteria diet

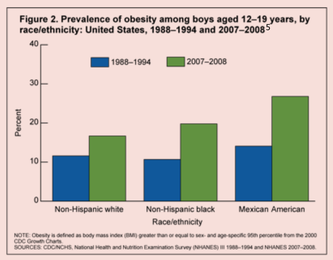
Mariska Silas, Theresa Gagnon, Matthew Jeffers, Dr. Dale Corbett
Department of Cellular and Molecular medicine, University of Ottawa, Ontario, Canada

Introduction

A ischemic stroke is characterized as an incident during which a reduction in blood flow to the brain causes alterations to cellular function and possible cell death[1]. This leaves survivors significantly disabled and often needing assistance in daily tasks. Studies show that stroke and heart disease were the two leading causes of death worldwide from 1990 to 2012[2]. In 2014 it was estimated that 405 000 Canadians were living with the effects of stroke and this number is estimated to double in certain regions of Canada within the next 20 years[3].

With the increasing amount of individuals younger than 65 affected by ischemic stroke, most notably children and youth, the prevalence of many stroke risk factors, such as diabetes and obesity in young age, are suggested to be related[2]. Due to the epidemic of diet-induced obesity and diabetes in North America, it is essential to further understand the role of diet in modulation of stroke in order to determine future treatment possibilities.

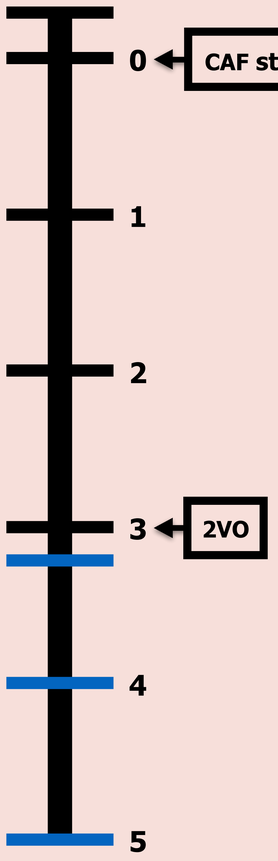
Figure 1. Photo showing childhood obesity[4].



Objective

The aim of this study was to observe the synergistic effect of an unhealthy diet and preclinical VCI on structural and functional characteristics of the brain. While extensive research has been done on the **risk** of stroke following a western diet, very little has been conducted in regard to the **severity of the outcome** of stroke following this diet. Additionally, the cafeteria diet used in this study is a more accurate duplication of common human eating conditions than traditional methods used and most closely reflects metabolic syndrome and obesity in humans, as noted by Sampey et al[6]. These diet considerations, combined with the 2VO surgery, will contribute to a representative animal model of stroke modulated by an unhealthy diet that could also aid in understanding the role of diet in conditions such as Alzheimer's disease and dementia.

Methodology



= MRI and Sacrifice Points

Figure 3. Experimental Timeline by Month.

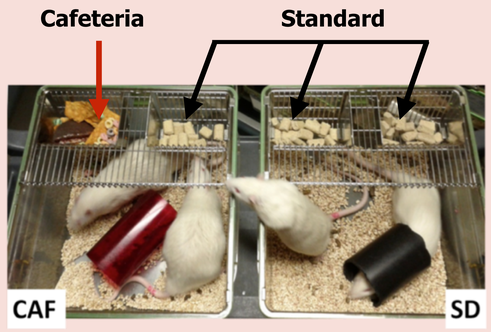


Figure 4. Cafeteria and Standard diet group rat cage layout.

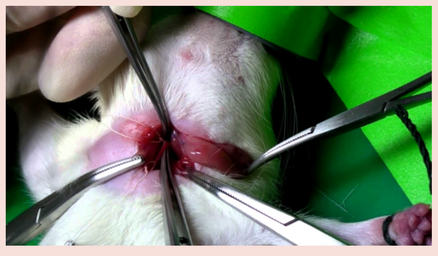


Figure 5. 2VO surgery on Sprague-Dawley rat[7].

0-3 months Rats were divided into two groups and assigned either a standard rat food (STD) diet or a cafeteria (CAF) diet. The CAF diet consisted of processed foods commonly found in grocery stores, such as cookies, cereal, chips and processed meats. Rats in the CAF diet group were given the choice to eat the 'junk food' or standard chow (Figure 4). Both groups were placed on their respective diets for a 3 month period.

2VO After 3 months, the animals were divided into two surgical groups. One group received a SHAM surgery while the other underwent a 2-vessel occlusion (2VO) surgery. Ligation of both carotid arteries was performed according to the 2VO model, causing hypoperfusion in the cerebral cortex. The animals continued to receive their diets throughout the experiment.

Post-surgical period Rats were further subdivided into 3 sacrifice time-point groups. One week, one month and two months after surgery their cerebral blood flow was measured in the pre-clinical MRI facility. The subgroups of animals were sacrificed the day following MRI imaging.
After all animals were sacrificed, the brains were removed and placed in a paraformaldehyde solution to be stored. Brains were then frozen using cooled isopentane in order to prepare the tissue for sectioning. Sections of the entire hippocampal region of the brain were collected and placed on slides. These slides were stained with cresyl violet (figure 6) and will undergo a microscopic assessment in weeks to come.

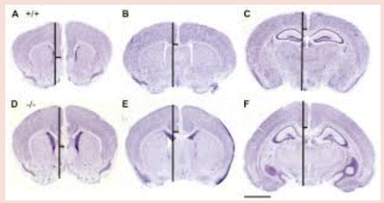


Figure 6. Slide containing 6 sections of tissue stained with cresyl violet[8].

Results & discussion

Macronutrient consumption of rats in the cafeteria diet group was was found to accurately mimic the common western diet, thus confirming our goal of creating a similar nutrient profile.

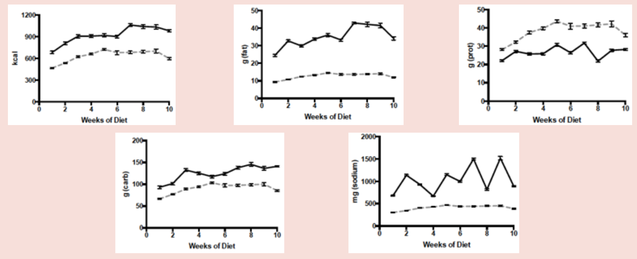


Figure 6. Nutrient intake of rats in standard (- - -) and cafeteria (—) groups.

In weeks to come microscopic assessments of brain damage will be quantified in order to give insight on the effects of western diet on cell damage and death in the hippocampal region. Further research will focus on identifying behavioural discrepancies between the two diet groups following surgery-induced stroke.

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