

The effect of ovarian hormones and the menstrual cycle on vessel hemodynamics (CYCLIC): a pilot study

Alice Yu, Robert-James Doonan*, Patrick Scheffler, Giordano Egiziano, Stella Styliani Daskalopoulou

Introduction: Increased arterial stiffness is directly associated with increased risk of cardiovascular complications and evidence suggests that ovarian hormones may play a role in arterial stiffness. However, current evidence regarding changes in vessel hemodynamics (arterial stiffness) during the menstrual cycle is controversial, and no studies have examined the effects of oral contraceptives (OCs) on vessel hemodynamics. Furthermore, it is important to assess the response of the arteries to dynamic changes, such as acute exercise, in order to capture critical information about the functional capacity of arteries, or the 'vascular reserve' in OC-users and non-OC-users. The purpose of this pilot study was to estimate the association between the phases of the menstrual cycle and vessel hemodynamics in OC-users and non-OC-users.

Methods: We recruited 30 healthy women (18-30y), who were taking OCs (n=6) or not (n=24). Vessel hemodynamic parameters [augmentation index, carotid-femoral pulse wave velocity (cfPWV), and carotid-radial pulse wave velocity (crPWV)] were measured, using a non-invasive, highly reproducible technique (applanation tonometry), at rest and 5-, 10-, and 15-minutes following a Bruce protocol treadmill exercise test to exhaustion. cfPWV was also measured 2-minutes post-exercise. The protocol was repeated at the three phases of the menstrual cycle of non-OC users: a) early-follicular (visit 1, mean day 6.1), b) late-follicular (visit 2, mean day 14.3), and c) luteal (visit 3, mean day 22) in a randomized order. OC-users were evaluated at approximately the same point in their cycles, with 2 assessments on OC (mean days 13.1 and 20.8) and 1 assessment off OC (mean day 2.9).

Results: Non-OC-users: cfPWV and augmentation index increased post-exercise in all visits ($P<0.05$). However, cfPWV returns to baseline at 15-minutes only during visit 3, whereas augmentation index returns to baseline at 15-minutes only in visit 1. Baseline values were not significantly different. crPWV increased significantly from baseline at 5-minutes post-exercise only in visit 2.

OC-users: Baseline, but not post-exercise, augmentation index decreased from visit 1 ($-2.58\pm 3.53\%$) to visit 3 ($-11.08\pm 4.01\%$, $P<0.05$). Differences between visits for cfPWV was only apparent at 15-minutes, where it was lower in visit 1 (off OC) compared to visit 2 and 3 (on OC) ($P<0.05$). Furthermore, crPWV only increased 5-minutes post-exercise during visit 2 and 3 (on OC) ($P<0.05$). Differences between non-OC-users and OC-users were not significant, probably due to small sample size.

Discussion: In this pilot study, we have shown that differences in vessel hemodynamics exist throughout the menstrual cycle, and different arterial beds may exhibit increased or decreased arterial stiffness depending on the menstrual cycle phase. Moreover, these differences are not always apparent at baseline, but only after acute exercise, indicating that ovarian hormones may affect the 'vascular reserve'. OCs seem to have a detrimental effect, increasing the stiffness of the arteries post-exercise and slowing recovery.

Author Affiliations: Department of Medicine, McGill University Health Centre, McGill University, Montreal, Quebec

Conflicts of Interest: None.