Does daily consumption of vitamin K1 from green cruciferous vegetables reach the circulation and the knee joint?

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Objectives: To determine as part of a feasibility study, plasma vitamin K1 (phylloquinone) concentrations in response to a broccoli-based dietary intervention in adults with knee osteoarthritis undergoing total knee replacement surgery, and to evaluate whether vitamin K1 can be detected in synovial fluid of the knee joint.

Introduction

Osteoarthritis (OA) is the most prevalent joint disease in older adults and a major cause of disability. Aside from its role in blood coagulation, vitamin K acts as an enzyme co-factor which carboxylates vitamin K-dependent proteins and is associated with cardio-metabolic¹ and musculoskeletal² benefit. Vitamin K1 (phylloquinone) is abundant in green leafy vegetables such as broccoli, spinach and kale, however, 55% of Irish adults have phylloquinone intakes below the EU recommendation of 1 µg·kg body weight⁻¹·day³. Emerging observational data indicate low vitamin K1 status is associated with a higher incidence of OA⁴.

Methods

Men and post-menopausal women awaiting total knee replacement surgery were enrolled in this feasibility study with a parallel design as described previously⁵. Participants (n=37, men/women 17/20, aged 70±8.5yr) underwent a washout for 7-d, where cruciferous vegetable consumption was restricted; prior to being randomised to either increased broccoli consumption (100g of cooked broccoli/d (treatment n=17)) or no broccoli consumption (control n=20) for 14-d prior to surgery (Fig 1). Fasting blood samples were collected at baseline (BL) and post-intervention (PI) (on the morning of surgery). A synovial fluid sample was collected during surgery (n=23; control=13, treatment=10). Vitamin K1 concentrations were measured in plasma and synovial fluid using reversed phase-HPLC.

Results

- Vitamin K1 concentrations did not differ across treatments at BL ($P = 0.916$).
- Mean (SD) vitamin K1 concentrations increased significantly in the treatment (BL: 1.04 (0.9); PI: 1.82 (1.6) nmol/L) compared to the control group (BL: 1.01 (1.1); PI: 0.71 (0.5) nmol/L) ($P = 0.001$) (Fig. 2).

Figure 2: Mean fold change in plasma vitamin K1 concentrations by treatment (n=37) (Independent t test).

- Mean (SD) vitamin K1 was detected in the synovial fluid and was significantly higher in the treatment (0.24 (0.2) nmol/L) compared to the control group (0.11 (0.1) nmol/L) ($P = 0.026$) (Fig. 3).

Figure 3: Mean vitamin K1 concentrations in synovial fluid by treatment (n=23) (Independent t test).

Discussion

- Results suggest that a modest intake of broccoli (100g/d) for two weeks significantly increased circulating vitamin K1 concentrations.
- The potential to modulate vitamin K1 in synovial fluid of the knee joint in response to dietary intervention warrants further investigation.

References

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