

## Menstrual cycle control in female astronauts and the associated risk of venous thromboembolism

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Venous thromboembolism (VTE) is a common and serious condition affecting approximately 1-2 per 1000 people in the USA every year. There have been no documented case reports of VTE in female astronauts during spaceflight in the published literature. Some female astronauts use hormonal contraception to control their menstrual cycles and it is currently unknown how this affects their risk of VTE. Current terrestrial risk prediction models do not account for the spaceflight environment and the physiological changes associated with it. We therefore aim to estimate a specific risk score for female astronauts who are taking hormonal contraception for menstrual cycle control, to deduce whether they are at an elevated risk of VTE.

A systematic review of the literature was conducted in order to identify and quantify known terrestrial risk factors for VTE. Studies involving analogues for the female astronaut population were also reviewed, for example, military personnel who use the oral contraceptive pill for menstrual suppression. Well known terrestrial risk factors, for example, obesity or smoking would not be applicable to our study population as these candidates would have been excluded during astronaut selection processes. Other risk factors for VTE include hormonal therapy, lower limb paralysis, physical inactivity, hyperhomocysteinemia, low methylfolate levels and minor injuries, all of which potentially apply to crew members. LSAH data will be assessed to identify which of these risk factors are applicable to our astronaut population. Using known terrestrial risk data, an overall estimated risk of VTE for female astronauts using menstrual cycle control methods will therefore be calculated. We predict this will be higher than the general population but not significantly higher requiring thromboprophylaxis.

This study attempts to delineate what is assumed to be true of our astronaut population, for example, they are known to be a healthy fit cohort of individuals, and combine physiological impacts of spaceflight (cephalic fluid shifts, lower limb inactivity) to understand specific risks associated with hormonal contraception.

(293/300 words)

Learning Objective:

- Review the aetiology of venous thromboembolism.
- Understand the specific risk factors for VTE for female astronauts using hormonal contraception.

Maintenance of Certification Questions:

1. The most common form of menstrual cycle control method used by female astronauts is the oral contraceptive pill. **A: TRUE B: FALSE**
2. Terrestrial use of combined oral contraceptive pill increases baseline risk of VTE: A) Does not increase risk **B) 2 fold C) four fold D) eight fold.**
3. Hyperhomocysteinemia doubles the risk of VTE; therefore decreasing the levels of homocysteine in the blood, reduces the risk of VTE. A)TRUE **B) FALSE**