

## Editorial Focus

# Hypergravity and microgravity influence haemostasis

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Cosmonauts flying to the International Space Station with the Sojuz rocket or taikonauts in their space capsule have to sit in their chair inside the narrow space capsule for up to two days. Thus, they seem to be susceptible to the risk of venous thrombosis and thromboembolism like anybody sitting with knees bent for an extended period of time, e.g. during air travel. Nevertheless, no report of any thromboembolic incident has been published from human spaceflight. Indeed, the possible influence of altered gravity on thrombosis and haemorrhage has not been in the focus of basic or applied scientists so far. One reason may be that circulating blood is continuously underlying low (in the venous system) or high acceleration forces, respectively, as in the heart.

In the current issue of *Thrombosis and Haemostasis* Dai et al. (1) open an important new field of research with interest both for basic and applied research and may explain, why astronauts are not experiencing thromboembolism despite extensive sitting during their spaceflights. Over recent decades, much evidence has been gathered that microgravity changes cellular functions, e.g. microgravity influences signal transduction pathways, apop-

toxis, the cytoskeleton and cell migration properties (2–5). As immune cell function is of high interest for human spaceflight, much interest has focused on immune function in weightlessness. Results from various groups have shown that immune cell reactivities of lymphocytes, monocytes macrophages and neutrophilic granulocytes are strongly suppressed in weightlessness (6, 7). This is of high operational importance and makes quarantine periods before space missions indispensable.

Little is known about the effects of hypergravity on cell functions. Dai et al. (1) report that hypergravity often appears to exert opposite effects to those of hypogravity. Their report indicates that in future more caution should be put on the risk of thromboembolic events during and after roller coaster rides or high G profiles during flights. These results may also influence jurisdiction, as events of coronary infarction, haemorrhage, cerebral infarction etc. can be causally linked to a specific event of hypergravity. Therefore, from now on operators should specifically warn about these risks or define clear exclusion criteria to avoid exposure of persons with increased risk of thromboembolic events to hypergravity situations.

## References

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