

Influence of aircraft chair quality on blood coagulation and leg edema formation during a simulated long-haul flight

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Introduction

World wide approximately 1.5 billion passengers travel by aircrafts yearly. In the past years there have been increasing reports suggesting a causal link between long-haul flights and thromboembolic events. It has been postulated that besides sitting in a cramped position DVT may be triggered by aircraft-specific factors. Whether these aircraft-specific factors (moderate hypoxia, low humidity) may in fact induce hemostatic changes thus triggering DVT is discussed controversially. Recently, we measured parameters of hemostasis in 20 passengers during and after a return flight from Vienna to Washington (ref. 1). A hypercoagulable state was found as evidenced by thrombelastographic measurements, by an increased activity of clotting factors FVII and FVIII and suppressed fibrinolysis. There was no evidence of a pronounced thrombin and fibrin formation. At present it is controversially discussed whether these findings are aircraft-specific or the consequences of sitting in a cramped position. In order to clarify this issue we performed a long distance bus travel (10 hrs) using the same protocol as in the ECS-study. Similar to long-haul flights we could demonstrate a certain activation of the coagulation system even after a long-distance bus travel in healthy subjects (ref. 2).

Leg edema, as a sign of venous stasis is a well-known problem among passengers during and after long haul flights. Until now no investigations have been made on the development of leg edema and fluid shifts under real flight- and bus-travel conditions. Plethysmographic measurements were carried out using an optoelectronic scanner system (Perometer®) in order to evaluate edema formation in the leg during the ECS- and the BUS-study. In both studies leg volume increased between 100 and 150 ml per leg (ref.3).

However, at present there are no studies available which investigated the contribution of the seat quality on measured changes of coagulation and leg volume during prolonged sitting in a cramped position. Therefore, the study "SEAT2003" was performed in order to measure changes in coagulation and edema formation during and after 10 hrs sitting.

Study Design

After laboratory screening 12 healthy participants (9 men, 3 women; mean age 37 years; BMI 25) were included in the study. All participants had a low risk profile for the development of deep venous thrombosis. They were sitting for ten hours in aircraft seats (high quality seats with special multi-part cushion construction) which were mounted in a special chamber that allowed us to create normobaric hypoxic conditions similar to an aircraft environment (i.e., 2.000 m – 2.400 m altitude). Baseline investigation were done before sitting, immediately after the 10 hrs sitting as well as one day thereafter. Blood was collected from an antecubital vein.

Plethysmographic measurements were carried out using an optoelectronic scanner system (Perometer®).

Results

No participant developed venous thrombosis of the leg as evaluated by duplex sonography.

Coagulation (in short): We did not find any significant changes in thrombelastographic measurements after prolonged sitting. There was a tendency towards a shortening of clot formation (shortening of activated partial thromboplastin time, aPTT). There were no pronounced changes in single coagulation factors and coagulation inhibitors measured after the 10 hrs sitting period (i.e., factor VII, factor VIII, protein C, protein S). In addition, there was no evidence for intravasal thrombin formation (no change in thrombin-antithrombin-complexes, TAT) or accelerated fibrinolysis (plasmin- α 2 antiplasmin-complexes, PAP).

Leg volume: Volume of both legs increased significantly after the 10hrs. This increase in leg volume was exclusively due to fluid accumulation in the calf. Immediately after the 10 hrs calf volume was increased by about 150 ml in both legs and normalized within 24h after termination of the sitting phase.

Conclusions

In our project "SEAT2003" we could not find any relevant changes in the coagulation system after prolonged sitting for 10hrs in a high quality aircraft chair. This is in contrast to our recent observations of an activated coagulation system after a long-haul flight and a long-distance bus travel, respectively. However, the degree of increase in leg and calf volume was comparable with the project ECS and the BUS-study. At present, we have no convincing evidence for the pathophysiological mechanisms behind our observations. Possible contributing factors are: A) The chairs used in our project "SEAT2003" were more convenient from a personal and a biomechanical point of view as compared to the chairs in the flight- and bus-study. B) Prolonged sitting under simulated conditions even under moderate hypoxia do not reflect the scenario when passengers are traveling by air or by bus. Therefore, further studies are required in order to clarify these issues.

References

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