42th ESL Congress - European Society of Lymphology
May 13-14, 2016 Mulhouse, France

Effects of a short exposure to multidirectional vibrations (andullation®) on lymphatic system and skin microcirculation in mice

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INTRODUCTION: Whole Body Vibrations are frequently used in sports, wellbeing, and medical fields. Their physiological effects are intensively studied.

PURPOSE: To examine the short time effects of multidirectional vibrations (delivered in horizontal position) on the lymph node dye accumulation and skin microcirculation in mice.

METHODS *:*
Part 1 : Mice were randomly allocated to three groups: Whole Body Vibrations (30 Hz, 3 minutes) (N= 15), manual massage of injection sites (3 minutes) (N = 15) and a control group (N= 10). Interventions were applied after 20 µl footpad injections of Evans blue dye (EBD). Dye quantity determination (µg) in the popliteal nodes was assessed by spectrophotometry (620 nm). (Fig 1).
Part 2 : Different periods of andullation® (3, 6 and 10 minutes, 30Hz) were locally delivered in a horizontal position on the abdominal skin in 3 randomized groups of mice (N = 42). All groups were compared to a control group (N = 14). The 'in vivo' measuring of the arterial and venous diameters (Fig 2) was done before (T1) and after each vibration period (T2= 3 or 6 or 10 minutes) with ImageJ software.

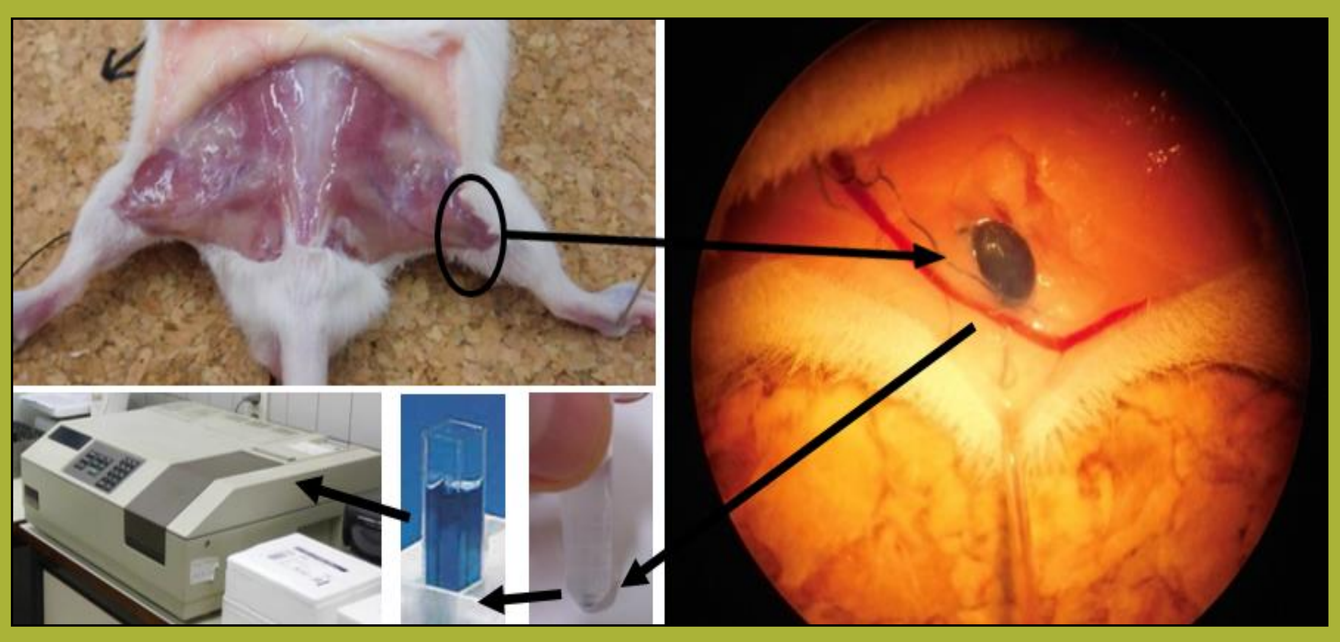

Fig 1: Dissection of popliteal lymph node and dye extraction for spectrophotometry analysis

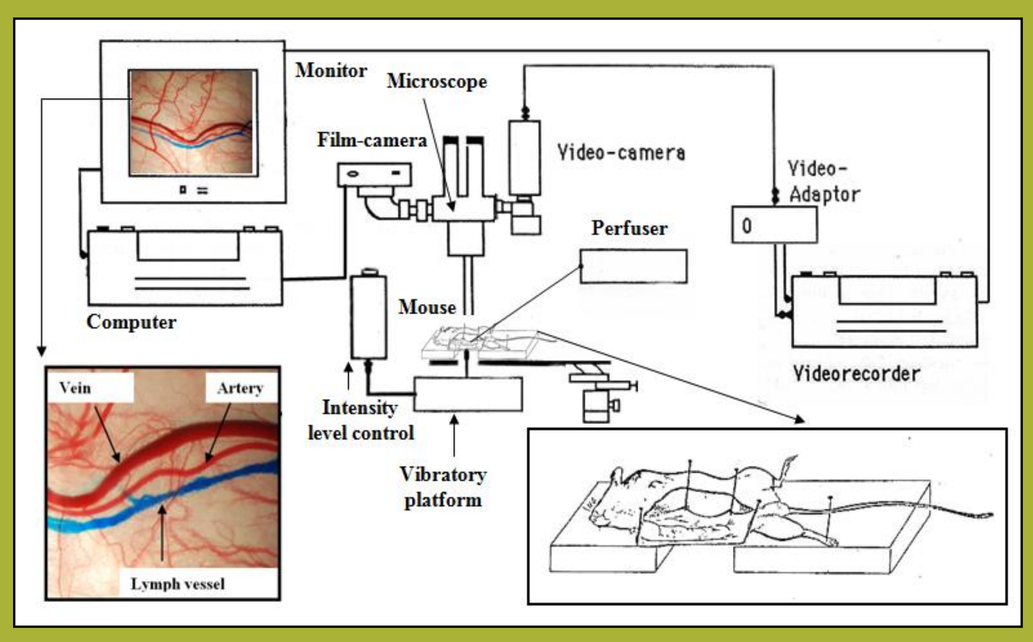

Fig 2: Material and device used during the visualization under microscope with the in vivo transillumination technique. The subcutaneous vessels of the abdomen of the mouse after Blue Evans injection.

RESULTS :
Part 1 : After vibrations, the quantity (mean±sd) of EBD in popliteal nodes was found higher in the WBV mice than in the control or massage groups (respectively, 0.56 ±0.26, 0.14±0.17, p<0.05, 0.22±0.16, p<0.05).(Fig 3).
Part2: Average venous diameters after 6 to 10 minutes of andullation® were significantly increased (7 and 12 %, p-values 0.026 and 0.013, fig 4), while 3 minutes did not significantly influence average venous diameters (Fig 5 a). Arterial diameters did not significantly vary after 3, 6 and 10 minutes (Fig 5 b). As for the placebo group, variations of arterial and venous diameters during 10 minutes were not significant.

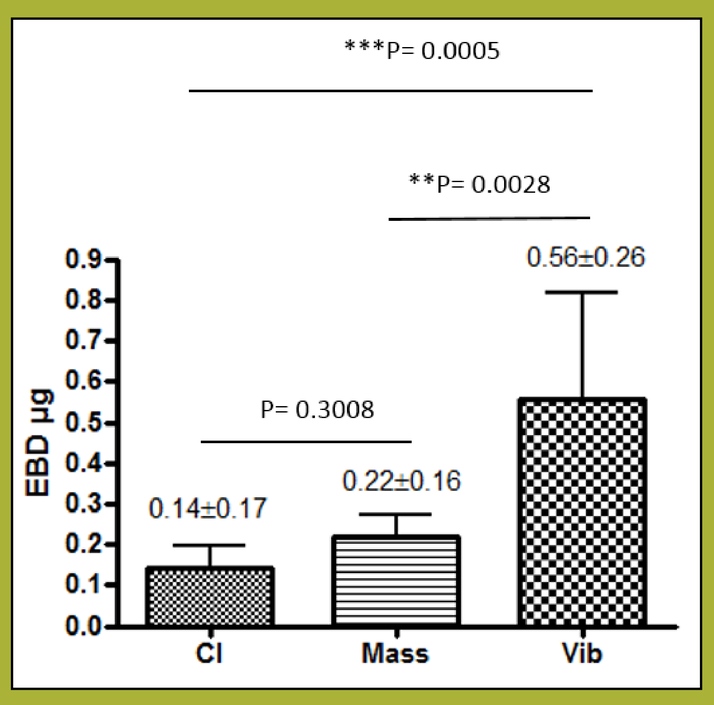

Fig 3: EBD (µg) in popliteal lymph nodes . (mean and sd)

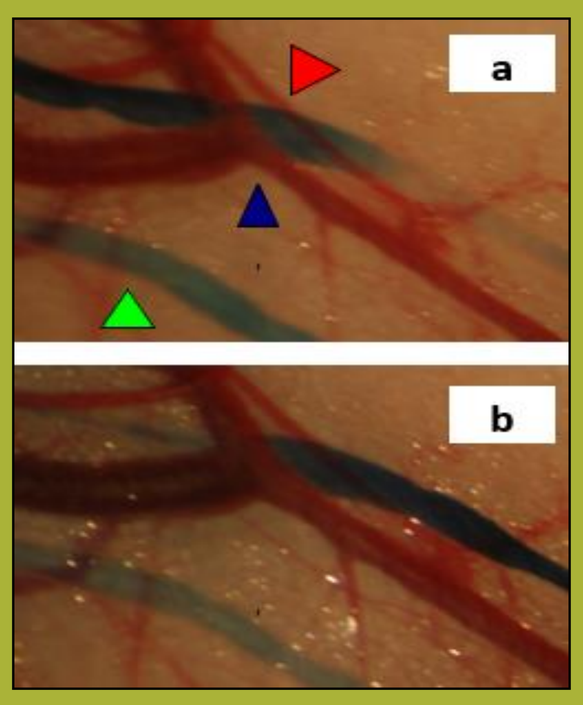

Fig 4: Microscopic view of the vascular vessels of the mouse's abdominal skin internal face. Green arrow: lymphatic vessels after blue dye injection, red arrow: artery, blue arrow: vein. Picture a before vibrations, picture b after 6 minutes vibration.

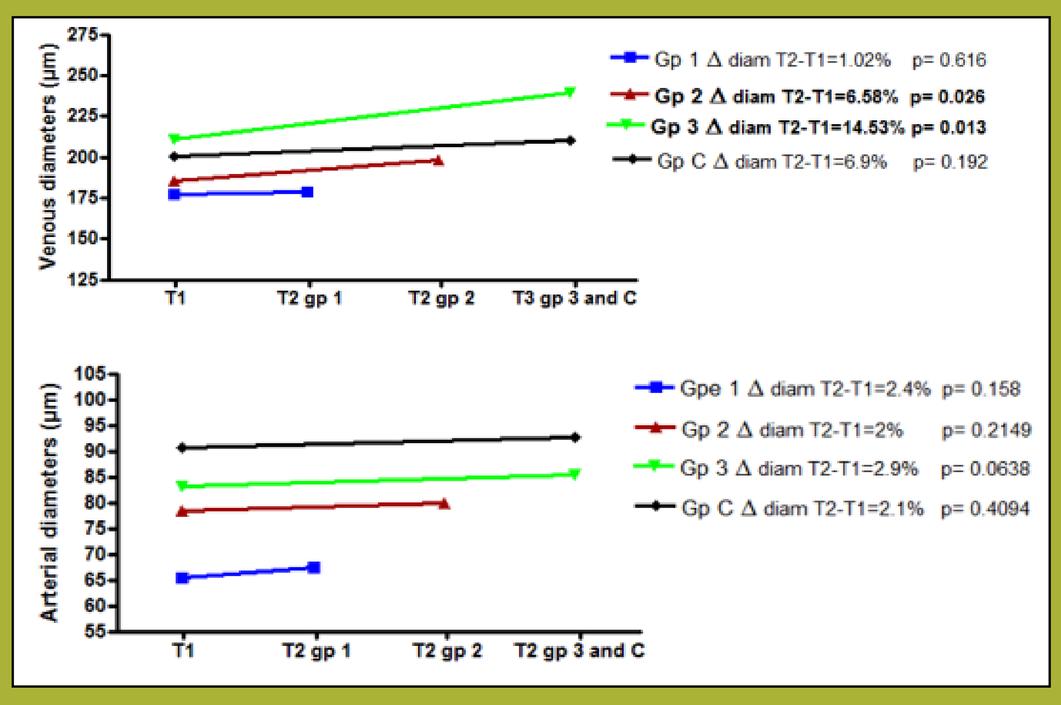

Fig 5: Venous and arterial diameters for the 4 groups

CONCLUSIONS: Lymph node dye accumulation is better after a short andullation® exposure than without intervention or with injection site massage. Vasodilatory effect of low frequency vibrations was demonstrated. An endothelium "shear stress" induced by "skin massage" is retained as hypothesis and generates local venous vasodilation and local subcutaneous blood flow increase.

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