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The ‘urge to move’ on body supports

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Abstract. It is well known that people that sit or lie down for prolonged periods change their posture on a regular basis. Even when people are asleep on average 20-40 postural can be observed during an 8 hours period of night rest. One of the reasons that can be found in literature for this ‘urge to move’ is that these movements are necessary to persevere the blood flow in the tissue. The aim of this paper is to study the relation between tissue perfusion and pressure on the tissue and frequency of the load cycle. Each subject is subjected to a treatment scheme that varies in pressure and frequency of the load on the tissue. The pressure levels that are used are 2.7 kPa, 4.0 kPa and 5.3 kPa and the frequency levels that are used are loading/unloading at intervals of 5 min., 10 min., 15 min. Statistics shows that for 2.7 kPa there is a significant reduction of blood flow between time intervals of 5 min. and 10 min. (P=0.028), and 5 min. and 15 min. (p=0.009). Statistics also shows that there is no significant reduction in blood flow at the time interval of 10 minutes, for every level of pressure. This series of measurements seems to suggest that at the time interval of 10 minutes for every level of pressure the blood flow does not decrease compared to the start situation.

Keywords: bed, mattress, blood perfusion

1. Introduction

It is well known that people that sit or lie down for prolonged periods change their posture on a regular basis. Even when people are asleep on average 20-40 postural can be observed during an 8 hours period of night rest [1, 2].

One of the reasons that can be found in literature for this ‘urge to move’ is that these movements are necessary to persevere the blood flow in the tissue. Because the blood flow can be obstructed by occlusion of the blood vessels when the tissue is under external pressure, the body reacts on this by (sometime unconsciously) changing the posture and thus unload the tissue that is obstructed and load another part of the body.

The question that arises is, what frequency of loading and unloading of the tissue is necessary in order to keep the blood flow at an acceptable level? Therefore, the aim of this paper is to study the relation between tissue perfusion and pressure on the tissue and frequency of the load cycle.

2. Materials and methods

10 healthy subjects (age 22.1 (s.d. 2.3) year, length 1.75 (s.d. 0.1) cm, weight 69.2 (s.d. 12.2) kg) lie down on a consumer mattress (AVS Maestro, Auping) while the pressure on their left buttock is measured with a calibrated measurement system (mFlex, Vista Medical). The blood flow in the tissue of the left buttock is measured by means of a flexible and thin laser Doppler probe (Laserflo BPM2 Laser Doppler Softflo 90 mm probe, Vasamedics). The blood flow is presented in milliliter blood per minute, per 100 gram tissue. (ml/min/100g tissue).

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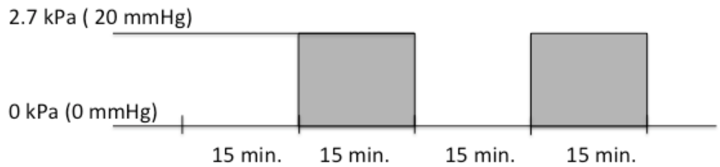

Fig. 1 The loading, unloading scheme of 2.7 kPa (20 mmHg) and 15 minutes

Table 1
Pressure-time treatments for all subjects.

Pressure [kPa] (mmHg)	Time interval [min.]		
2.7 (20)	5	10	15
4.0 (30)	-	10	-
5.3 (40)	5	10	15

Each subject is subjected to a treatment scheme that varies in pressure and frequency of the load on the tissue. Every treatment in the scheme (total 7 circumstances) is applied for 1 hour. The pressure levels that are used are 2.7 kPa, 4.0 kPa and 5.3 kPa (20 mmHg, 30 mmHg and 40 mmHg), and the frequency levels that are used are loading/unloading at intervals of 5 min., 10 min., 15 min. During each hour we started in the unloaded situation, and ended with the loaded situation. For example see Figure 1 for the loading, unloading scheme of 2.7 kPa (20 mmHg) and 15 minutes.

Table 1 shows the treatments that were applied to every subject.

The variable that is used for statistics is the difference in the average blood perfusion (ml/min/100g tissue) between the first time interval and the last time interval during the 1 hour test. Thus 'bloodperfusion end' minus 'bloodperfusion beginning'.

With a paired t-test every combination of pressure (p_{20}, p_{30}, p_{40}) and time intervals (t_5, t_{10}, t_{15}) is tested on a significant difference in blood flow, so the hypothesis that is tested is:

H0: $\mu_{p1,t1} = \mu_{p2,t2}$ (for every combination of p_{xx} and t_{xx})
H1: $\mu_{p1,t1} \neq \mu_{p2,t2}$

PASW Statistics 18.0 is used for statistics and the level of significance is α=0.05.

3. Results

A typical example of the changes in blood perfusion can be seen in Figure 2. The average results on all subjects can be seen in Figure 3.

Statistics shows that for 2.7 kPa (20 mmHg) there is a significant reduction of blood flow between time intervals of 5 min. and 10 min. (P=0.028), and 5 min. and 15 min. (p=0.009).

Statistics also shows that there is no significant reduction in blood flow at the time interval of 10 minutes, for every level of pressure 2.7 kPa, 4.0 kPa and 5.3 kPa (20 mmHg, 30 mmHg and 40 mmHg), (paired t-test H0: $\mu_{d1,10\ min} = 0$ results in p=0.71, p=0.51, p=0.18).

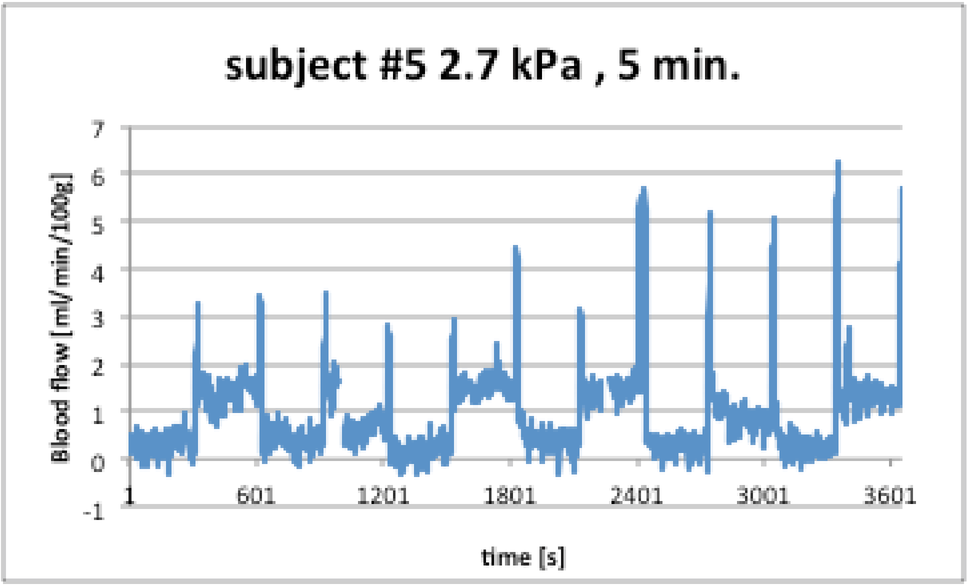

Fig. 2 Blood flow as measured in the left buttock of a subject that has a load/unload cycle every 5 minutes (600 second) with a pressure on the tissue of 2.7 kPa (20 mmHg). The spikes that can be seen in the data are due to disturbances caused by turning of the subject. These spikes are not taken into account when calculating the average perfusion.The difference between the average blood flow in the first (unloaded) interval is and to the last (loaded) interval is used for statistics

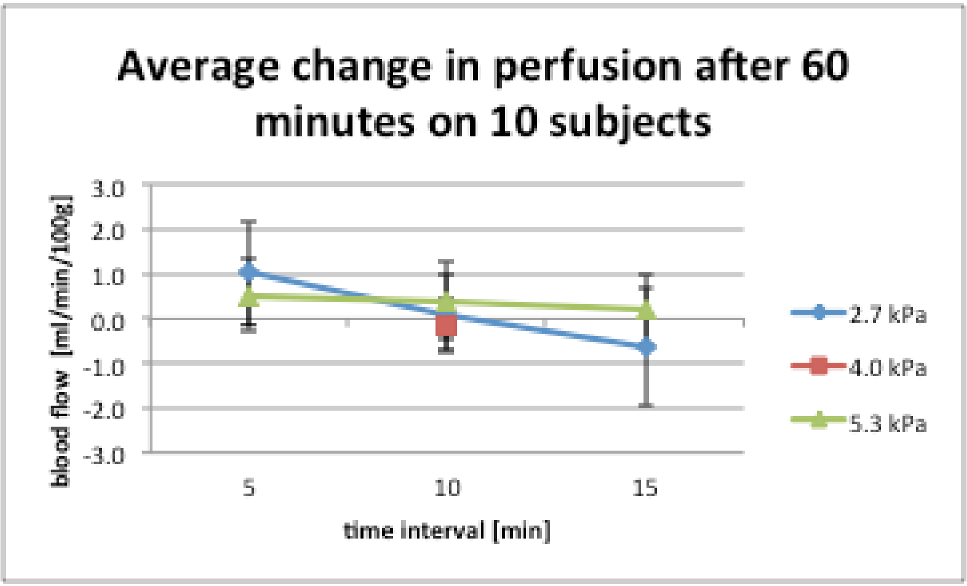

Fig.3. The average difference in blood flow after 60 minutes on all subjects, for all combinations of pressure and time intervals.

4. Discussion

To answer the question how much movements are needed minimally when the body is supported, it seems reasonable to assume that the blood flow should not decrease compared to the start situation.

Although this data shows large differences between subjects, an interesting aspect in this data is that it suggests that the blood flow increases compared to the starting (and thus unloaded) situation when time intervals of 5 minutes are applied.

Also this series of measurements seems to suggest that when the time interval is about 10 minutes, that for every level of pressure between 2.7 kPa and 5.3 kPa (20 and 40 mmHg) the blood flow remains unchanged. These pressure levels are typically measured on the buttocks of healthy users on consumer beds.

This necessary time interval of 10 minutes is in line with other research in which 20-40 posture changes are measured during an 8 hours sleep.

References

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