CLINICAL APPROACHES (FASCIA)

Fasciatherapy combined with pulsology touch induces changes in blood turbulence potentially beneficial for vascular endothelium

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Summary Stress, whether physical or emotional, is known to challenge the hypothalamus–pituitary–adrenal axis and to induce important changes in the biochemical parameters of organ functions. The fascia is an elastic tissue that envelops the organs and reacts to stress by tightening, thus contributing to the dysfunction of the body. One of the unmistakable aspects of stress is that it induces vasomotor reactions. Both tightening of the fascia and vascular modifications are reversible, but sometimes tensions become embedded in the fascia and gradually begin to hinder specific functions of the body. Here we present the results of a study investigating the effects of a manual therapy (Fasciatherapy Méthode Danis Bois® combined with Pulsology Touch) applied to the artery. We have measured the modifications of important parameters contributing to vascular function. Our study shows that this manual approach is able to affect blood shear rate and blood flow turbulence in particular.

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Abbreviations: A, acceleration; DE, diastolic elongation; DW, dark window; MV, maximum velocity; PTSD, post-traumatic stress disorder; T0, beginning of measurement sequence; T10, measurement after 10 min rest; T20, measurement after 10 min pulsotherapy or massage; NO, nitric oxide.

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It is possible to perceive irregularities within a single pulsation

_Galen_

**Introduction**

Fascia is a connective tissue enfolding and separating the anatomical structures of the body, such as muscles and tendons, but also visceral organs. Fascia is also constitutive of bone, vascular walls and even blood (Bichat, 1800). One of the main functions of the fascia is to contribute to tissues coherence and protect them from physical trauma. The manual approach at the heart of our study, fasciatherapy (Danis Bois Method\textsuperscript{16}) addresses the anatomy and structural segmentation of the fascia and acts more specifically on the elasticity of the tissue and on muscle tone. It is complemented by a specific technique, the “pulsology touch”, that acts on vascular resistance. Many of the manual approaches developed since the early XXth century aim to bring relief to the effects of connective tissue alterations. The approach used here is neither a massage nor a manipulation (Bois, 1984). We will use the term pulsotherapy, combining pulsology touch and fasciatherapy. It can be best described as a deep and gentle stretching of the body’s tissues. It consists of two distinct procedures. The first involves the assessment of the spontaneous rhythms manifesting in the patient’s connective tissues and perceived by the trained therapist through the touch that is specific to this approach (Quéré, 2004). This evaluation gives the therapist a precise indication about the organization of the tensions in the patient’s body. The second step is the supporting point. It corresponds to a phase of regulation of the patient’s body resulting in a tangible reduction in muscle and tissue tone, a synchronization of the pulses and release of tissue adherences.

Stress is an adaptation to an unacceptable disparity between reality and expectations, which can lead to anxiety and depression and does not exclude stress persistence. Ongoing stressful life conditions may lead to chronic somatic complaints. Stress also affects the arteries, which react as the fascia. Specifically, the adventitia reacts by tensing to stress, the _mediana_ reacts by constricting and the endothelium is challenged by blood flow changes induced by stress. In the long term these turbulences cause endothelial dysfunction and _in fine_ a persistent inflammatory reaction, common to chronic diseases (d’Alessio, 2004, 2005a–c).

Consequently, we were interested in assessing whether pulsotherapy could be considered a valuable treatment for the vascular consequences of stress. Therefore, we performed echo-Doppler measurements of a variety of vascular parameters on 16 stressed patients, either normotensive or hypertensive. We compared clinostatism, massage and pulsotherapy by measuring several parameters, indicative of flow and pulse alterations, or blood pressure. In particular we found that the main changes concerned blood turbulences and a decrease in peripheral resistances. In the following work we document the changes in blood parameters relevant to the individual’s stress reaction. We also validate the hypothesis that there is a direct link between stress and endothelial alteration through blood flow changes. Finally we establish that the effects of stress on the vascular target of stress can be reversed by a manual approach that addresses the artery in the way pulsotherapy does.

**Material and methods**

This study concerns both the effect of a treatment method and the type of pathological syndromes over which it might show significant results. Therefore, we organized our study into a repeated-measures design, comparing responses of 16 patients to 2 major types of treatments.

With regard to the treatments as the independent variables, our intention is to study the possible effectiveness of pulsotherapy over conventional massage. Therefore, we decided to compare 16 patient’s responses to a short application of a standardized pulsotherapy treatment vs. a short and standardized conventional body massage (see description below), both given by the same physical therapist, in order to avoid the necessity to study the therapist’s effect on the results. Our marker for both types of treatment is rest or clinostatism. We included 2 separate points of measurement—the first after rest and the second after the treatment—to answer the following questions: does the treatment—whether it is massage or pulsotherapy—affect stress vascular responses? Is the effect of pulsotherapy different from that of massage?

As for the pathological background, the 16 patients are composed of normotensive and hypertensive persons after validation of the tension status by the angiologist: 8 hypertensive, and 8 normotensive and stressed. The particular status of “normotensive and stressed” was defined in order to compare two populations that were expressing an inner sense of tension. Unfortunately our sample size was not large enough to allow computation of a fully reliable analysis of variance. Therefore, the distinctive responses that we actually observed...
depending on the patient’s pathological background are not further discussed.

The measurements were taken on the femoral arteries using Echo-Doppler (GE Vivid Expert 4) at three different times: before rest, after rest, and after treatment. Blood pressure was also measured at the same time.

The sequence of the protocol implemented on all 16 patients was the following:

- **T0**—before rest: Echo-Doppler and blood pressure measurements.
- **+10 min of rest**: the subject is lying on the massage table, resting with no activity of any sort, even to the exclusion of mental concentration or meditation.
- **T10**—end of rest, before treatment: Echo-Doppler and blood pressure measurements.
- **+10 min of treatment**: the treatments are given on different days; one day the patient received a conventional body massage, and another day the pulsotherapy treatment.
- **T20**—end of treatment: Echo-Doppler and blood pressure measurements.

This protocol produces two types of experimental sequences, conducted on all 16 patients: (1) the “massage” sequence from T0 to T20, in which the treatment given is a massage and (2) the “pulsotherapy” sequence from T0 to T20, in which the treatment given is pulsotherapy.

In the following, we detail the standardized treatment we applied, as well as the Echo-Doppler parameters.

**Description of the treatments**

Both techniques (conventional massage and pulsotherapy) are applied to the abdominal area, pelvis and lower limbs.

1. **Conventional massage**—using effleurage, petrissage, static and dynamic pressure, skin-rolling, kneading and stretching.

   The massage is given from the abdominal area down to the lower limbs, excluding the feet. It involves the muscles of the abdominal wall (rectus abdominis and external and internal obliques) integrating the underlying viscera, as well as the glutueus medius, tensor fasciae latae, quadriceps, hamstrings, adductors and calf muscles (gastrocnemius, soleus and calcaneal tendon).

2. **Pulsotherapy**
   2.1. First, the therapist places his hands on the abdominal viscera, embracing both the muscles of the abdominal walls, the viscera (colon and small intestine) and peritoneal fascia. The therapist aims to obtain a decrease in tensions and release of adhesions in the various layers of the fascia, from periphery to deeper layers. Using a slow and continuous movement, the therapist identifies the reactions of the connective tissues and analyses their responses in terms of orientation. As the unfolding and stretching of the tissue reaches its maximum amplitude, a *supporting point* is held, until tensions are released.

2.2. The touch is then applied to the area of the abdominal aorta. It acts directly on the artery, allowing simultaneously the assessment of vascular vasomotor responses and the regulation of tensions until a normal ample and diffusing pulse has been achieved.

2.3. Hands are then placed on the muscles of the thigh (quadriceps, adductors, tensor of the fasciae latae, and gluteus medius). Pulsotherapy is applied to both femoral arteries after they have crossed the inguinal ligament (a potential zone of compression for both arteries). The objective is to achieve a synchronization of right and left pulses and an optimum quality of the pulse wave. The assessment and the treatment occur simultaneously.

2.4. The treatment is then applied to the knee area, addressing first the calf muscles, then the popliteal arteries. Vasomotor response is evaluated on right and left arteries at the same time to compare both sides (bilateral pulsology). If they are not synchronized, a series of supporting points are applied to balance the pulse of the arteries.

2.5. In the final phase of the treatment protocol, the touch embraces wider areas, (quadriceps/abdomen and calf/abdomen) in order to balance the myotensive fascia throughout. This allows the different segments to unify into a physiological globality, thus permitting diffusion of a fluid sense of motion perceived by the patient following the successive tension releases.

**Description of Echo-Doppler parameters**

The modulations of the tracing relate to the propagation of the arterial wave. The tracing represents blood flow velocities at the point of measurement.
A systolic peak

- The ascending phase represents blood flow acceleration as the arterial wave propels the blood column.
- The descending phase represents blood flow deceleration followed by the rebound of the reflected arterial wave.

A diastolic wave, stretching between two systolic peaks, with its reduction in amplitude being in direct proportion to high downstream resistances.

Acceleration (A) is directly associated to the maximum velocity (MV) (systolic peak).

The blood flow profile—laminar or turbulent—is represented by the dark window (DW) parameter. When there is no DW under the systolic peak, it means that blood velocities are highly variable throughout the artery section at the point of measurement, going from 0 to the maximum speed value. This is an indicator of blood turbulence. When a DW appears, it indicates that blood velocities become more homogeneous, signaling a more regular and probably laminar blood flow (Figure 1).

Extensive systo-diastolic variations of blood flow velocities and the presence or absence of a flow during the diastolic phase diastolic elongation (DE) reflect the degree of vascular resistance.

Results

The only results computed into statistical analysis were the Echo-Doppler results. Rough data are presented as a large number of graphs, as shown in Figure 2. We systematically used right femoral artery responses.

The example presented in Figure 2 is a typical response amongst those we collected, showing the disappearance of turbulences as a DW significantly appears below the systolic peak.

We focused on 3 of the main parameters measured using Echo-Doppler, as they appeared physiologically meaningful to our purpose: MV, (DW) and diastolic elongation (DE). They constitute our dependant variables. Since our tools did not provide us with direct quantitative results for all of them, we decided to classify each parameter measurement within a 5 range grid of responses, based on the expertise of the angiologist and the physical therapist of our team: each MV, DW and DE measurement therefore shows responses ranked from 1 to 5, with 1 being the worst and 5 the best. The grid used for classification is presented in Figure 3. An assumption is made that there is continuous evolution of the signal from worst stage level 1 to best stage level 5.

The data analysis conducted is two-fold: first a simple frequency distribution analysis aims to visualize the body of evidence and general response

Figure 1 Illustration of the Echo-Doppler signal. y-axis is blood velocity, x-axis is time. A DW appears under the systolic peak of MV when systolic velocity heterogeneity decreases. MV can be read on ordinate axis. DE is the diastolic pattern connecting the finishing systol to the next systol.

Figure 2 Echography and Doppler effect measured on right femoral artery: (a) signal observed before pulsotherapy and (b) signal measured after pulsotherapy. The Echo-Doppler gives mostly visual and graphical information and computes a few values out of the graphical patterns such as acceleration (A).
behavior. Then a chi square analysis is computed to compare the different effects of pulsotherapy and massage over rest, then to compare one to the other.

Frequency distributions are shown in Figure 4. Continuous lines with triangles for figure (a) and continuous lines with crosses for figure (b) and (c) correspond to the massage sequences results, whereas continuous lines with a dot for figure (a) and continuous lines with a vertical bar for figure (b) and (c) correspond to the pulsotherapy sequences results. Dotted lines refer to T0 (short dots) and T10 (long dots) responses, and continuous lines refer to T20 responses (responses to treatment). T20 pulsotherapy responses are highlighted in bold in the three graphs (Table 1).

These graphs can be read as follows:

1. The mode of responses to DW parameter is positioned on level 2 for all stages of our experiment except for one: T20 measurements after pulsotherapy present a mode on level 3 revealing a probable effect of pulsotherapy treatment.
2. The other parameters MV and DE show very little differences on pulsotherapy responses.

This requiring further investigation, we conducted chi square analysis.

The chi square test was computed on a two-by-two basis (one degree of freedom) between:

- pulsotherapy and massage values issued from the T20 measurements,
- pulsotherapy and rest values issued from the T20 and T10 measurements of each pulsotherapy sequence,
- massage and rest values issued from the T20 and T10 measurements of each massage sequence.

The hypothesis tested is the difference of responses between treatments with reference to rest. Positive to negative (or null) effects, results of chi square show that for both DW values and MV:

- there is a significant difference between pulsotherapy and massage responses, i.e., there are significantly higher values for both DW and MV on
pulsotherapy results than on massage results ($p<0.001$);
- there is a significant difference between pulsotherapy and rest ($p<0.001$ for DW values and $p<0.005$ for MV values), i.e. values measured after pulsotherapy on DW and MV are significantly higher than just after rest;
- there is a difference of weaker significance between massage and rest for DW values ($p=0.07$) and no difference between massage and rest for MV values (i.e. no additional effect of massage over rest).

Chi square results show the following for DE values:
- no significant difference between treatments ($p=0.10247$) could be detected;
- no significance between massage and rest could be detected ($p>0.1$);
- a slight difference between pulsotherapy and rest is detected using DE ($p<0.01$).

In conclusion, DWs and MVs are significantly improved after pulsotherapy treatment, and the effect is much higher compared to rest and conventional massage. Massage has a positive impact on DWs over rest, but in a much weaker way than pulsotherapy does. No effects of massage can be observed on MVs. We therefore deduce that massage has probably no significant effect on blood velocities, neither on maximum speed nor on transsectional distribution.

Pulsotherapy results, despite the limited number of subjects enrolled in this study, allow us to assume that it has a significant effect on reducing heterogeneous blood velocity profiles throughout the measured section, and simultaneously favors an increase in blood MV.

Discussion

Stress is a systemic reaction affecting the individual’s psycho-somatic integrity, alerting him that adaptation to a given situation is becoming urgent (d’Alessio, 2005a). In medical terms, although this adaptive constraint can induce pathologies, stress itself is not yet recognized as a true etiopathogenic factor. For a long time, only “extreme” stress has been recognized to induce propensity to infection or hypertension. Now we know that even “moderate” stress such as maternal separation, immobilization, stressful life events in the middle-aged and the elderly, and academic stress (Chandola et al., 2008) are all able (independently from conventional risk factors such as dietary stress and smoking) to alter life quality and shorten lifespan by reducing normal resistance (Bisson et al., 2008). Vascular alterations—either hypertension or atherosclerosis—have been shown to be linked to emotional stress, post-traumatic stress disorder (PTSD) and psycho-social discomfort (d’Alessio, 2004). Recently, anxiety has been shown to worsen prognosis in patients with coronary artery disease (Shibeshi et al., 2007). Thus, there is apparently a causal link between emotional stress and the dysfunction of the vascular/cardio-vascular system in particular. Indeed, stress has been shown to modify vascular parameters, inducing vasospams and transitory hypertension (Esler et al., 2008). Moreover, psycho-social stress has a profound impact on vascular endothelium, inducing systemic inflammation (d’Alessio, 2004, 2005b, c).

To conduct this study, we selected stressed normotensive subjects and hypertensive patients and compared the effect of pulsotherapy with clinostatic rest or massage. Only pulsotherapy was able to very significantly alter two of the vascular parameters we measured: DW and MV.

| Table 1 Results from the two-by-two chi square test computed on the dependant variable values, showing dependant variables in rows, and paired independent variables on columns. |
|---------------------------------|-----------------|-----------------|
|                                 | Massage vs. rest| Pulsotherapy vs. rest| Pulsotherapy vs. massage |
| $p$-Value                       |                 |                  |                     |
| DW                              | 0.07004         | 0.00041          | 0.00002             |
| DE                              | 0.36503         | 0.00658          | 0.10247             |
| MV                              | 1.00000         | 0.00349          | 0.00081             |
| Chi2                            |                 |                  |                     |
| DW                              | 3.282           | 12.500           | 18.286              |
| DE                              | 0.820           | 7.384            | 2.666               |
| MV                              | 0.000           | 8.534            | 11.222              |
The variations of the DW induced by pulsotherapy represent a decrease of the arterial wall rigidity at the point of measurement and those of the MV downstream of the point of measurement. We surmise that the pulsotherapy treatment (Quéré, 2007) does equalize blood velocities, thus allowing laminar flow to prevail over turbulences. This innovative manual approach is based on the application of supporting points that act directly on the artery. The ability of this touch to directly affect the arterial wall is probably at the base of the observed reduction in turbulence, finally beneficial to vascular endothelium (d’Alessio, 2004).

At this point in our study, several hypotheses can be displayed to explain the mechanism. We know that alterations in physical parameters such as tension can induce specific gene responses (Nauli et al., 2008). Therefore, we think that the effect of pulsotherapy observed on the artery could be the result of changes in the tensional field around the artery (Stephan, 2007). The observed effects on the blood velocities and on the lowering of turbulences imply that there is a relaxation of the intima associated to a relaxation of the media. These effects mimic nitric oxide (NO) release in response to acute pro-inflammatory or infectious conditions and are beneficial to endothelium in that they display an anti-inflammatory response (Sadeghi Zadeh et al., 2000).

We consider that the therapeutic effect of pulsotherapy is probably displayed in the following different systems: the neuro-vegetative system and its vasomotor function, probably NO mediated; the vascular system and the arterial intima and adventitia, probably following a direct response to pulsotherapy touch; the endothelium, through its indirect responses to treatment (induced by the shear stress modulation and the decrease in turbulences); finally, the blood itself, by its physical change in viscosity. Consequently, in the short term, the relief from tension is experienced by the subject under stress. In the long term, positive functional effects should be obtained on the recurrent stress consequences, which are propensity to infection, hypertension, thrombosis and immune imbalance.

In conclusion, in the context of stress, mood and emotional alterations, detrimental to health, it is possible to protect vascular endothelium with pulsotherapy. The specificity of this touch is that it impacts the anatomical structures involved in the signaling of endothelium-mediated inflammatory response. This study contributes with preliminary data to the validation of pulsotherapy as an innovative approach that could be usefully integrated into the treatment armory for these most frequent disorders.

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