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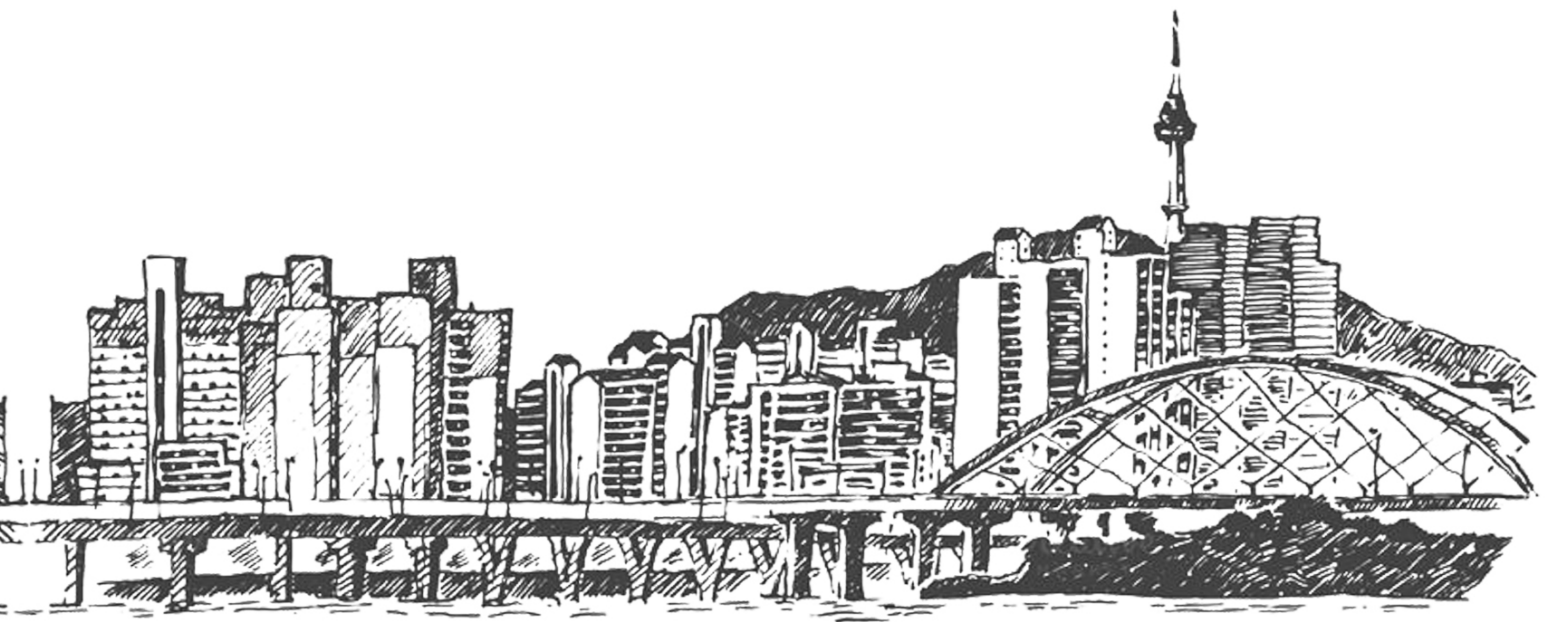
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ON THE DEFINITION OF INTERMITTENT PNEUMATIC COMPRESSION

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Background. The last two decades have been characterized by the widespread use of pneumatic compression therapy (PCT) technologies, the emergence of a wide range of uniform devices, and the use of trade names as terminology. The lack of standardization of terminology at both the international and national levels puts healthcare professionals in the position of having to conduct identity and differentiation expertise for various hardware models and techniques. Understanding what intermittent sequenced pneumatic compression (ISPC) is and is not, and how it relates to similar types of therapy, is necessary for the application of this technology in scientific research, licensing, and medical insurance.

Aim. Based on the classification and terminology that have emerged in the field of PCT, provide definitions of PCT and ISPC.

Methods. The classification being developed is aimed at practicing medical professionals and includes two levels: a synthetic level that contains generalized groups of tools primarily described from an engineering and technical perspective, and an applied level that includes specific therapeutic tools characterized from both engineering and clinical-biological perspectives. The terminology used comes from both modern English-language scientific medical literature sources and the practice of using terms that has developed in Ukraine over the past 20 years. The definitions provided are based on the identified relationships of subordination and affinity within the classification.

Results. The definition of ISPC remains a challenge. In our opinion, reduction or description is the optimal approach, as attempts to provide a direct definition of ISPC have been unsuccessful. Typically, any clear definition is incomplete [1, 2], while a relatively complete definition is incomprehensible. Such multifaceted phenomena as ISPC are better suited to large descriptive definitions [3], which, however, are not suitable for practical application. In some cases, it is considered better not to provide a definition and move directly to practical aspects [4, 5, 6].

Among all types of external pressure application used for therapeutic purposes, three groups can be distinguished:

- Variant where pressure is provided by the weight or muscle force of a person: manual and instrumental massage, acupressure, etc.;
- Variant where pressure is provided by tissue products (bandages, stockings, dressings, corsets, orthoses, etc.);
- Variant where pressure is provided by gels, fluids, powders, or gases. In the latter case, the working environment is most often air, so this group of therapeutic effects is conveniently called pneumatic compression therapy, PCT.

PCT can be divided into general, when the external pressure affects the whole body, and local (i.e., compressive local barotherapy), when pressure is applied to a specific limited area or part of the body. Although compressive local barotherapy can be carried out by direct contact of the body surface with a gas environment, such as in the Kravchenko barochamber, devices with pneumatic cuffs that are applied to the body surface and provide compression by changing their volume when filled with air have become more widespread.

The impact of the pneumatic cuffs can be either segmented, meaning that the compression can differ in different parts of the cuff, or non-segmented, meaning that the compression is done stereotypically and simultaneously in the entire cuff. At the same time, this impact can be continuous, meaning that the inflation of the cuff is done once at the beginning of the procedure, and deflation – once at the end, or intermittent, meaning that the compression by inflation and deflation by air discharge form a certain cycle that is repeated several times during the procedure.

Distinguishing between ISPC and other similar compression therapy methods requires a clinical-biological approach and cannot be done solely through engineering and technical means. Here are the main types of compression therapy methods:

- Intermittent sequenced pneumatic compression (ISPC, IPC) devices
- Air massage chairs
- Anti-decubitus mattresses
- Counterpulsation devices
- Pneumatic immobilization devices such as corsets and splints
- Pneumatic anti-shock garments
- Pneumatic tourniquets.

Unlike counterpulsation, ISPC does not aim to pulse-enhance myocardial blood flow or locally stop peripheral blood flow, and accordingly, compression is not associated with heart rhythm.

Similarly, unlike pneumatic anti-shock suits and pneumatic tourniquets, ISPC is not intended for long-term preservation of central hemodynamics in critical conditions, does not locally stop peripheral blood flow, and accordingly, compression is intermittent rather than long-term or permanent.

Likewise, unlike pneumatic immobilization devices, ISPC is not intended for immobilization, and accordingly, compression is intermittent rather than long-term or permanent.

Unlike anti-decubitus mattresses, the ISPC is not focused solely on local microcirculation, but stimulates physiological flows of intravascular fluids on a large scale or even throughout the body. To achieve this, ISPC compression is mostly designed to work around the circumference rather than on the body support plane. In contrast, the use and purpose of pressure ulcer prevention devices are strictly local.

Pneumatic massage chairs may be similar to the ISPC in terms of construction and procedure, but have a general health purpose, while the ISPC is a more specialized medical technology. Unlike the ISPC, pneumatic massage chairs, although they have significant recreational potential, are not medical devices, do not require a prescription or medical supervision, and are usually not optimized to work with specific diagnoses.

ISPC is a multifaceted phenomenon that can have different definitions depending on the context. In the context of clinical practice, six subtypes of ISPC can be distinguished.

One subtype of ISPC, traditionally called "pressotherapy" in Ukraine, is used in the cosmetic, wellness, and SPA industries. It is an element of comprehensive

restoration of skin elasticity and appearance (especially after surgical interventions and other damage). It is also a part of body shape correction and weight reduction through its impact on the subcutaneous tissue, mainly draining swelling. Other therapeutic benefits can also be expected, including muscle and psychoemotional relaxation. Pressotherapy devices are typically well-known for their simple control, good and convenient design, and typical large multi-chamber (>8 chambers) cuffs in the form of clothing elements (pants, sleeves, suits, etc.). Typical slow lymphatic drainage-oriented program modes are used. Very high pressure levels (>120 mmHg) are possible. Generally, the manufacturer does not provide clinical trials of the use of such devices in the treatment of diseases typical of other subtypes of ISPC.

The second subtype is used in sports medicine. In Ukraine, this direction does not have its own name because it is new and has not yet reached commercial distribution. It is optimized for rehabilitation for muscle and psychoemotional overload, rehabilitation and first aid for a wide range of injuries to the musculoskeletal system (primarily limbs). For this subtype of ISPC, typical devices with simple control are used, similar to those used for pressotherapy. They are usually portable with small cuffs with 4-6 chambers. Typical modes are lymphatic drainage. The range of pressure adjustment can include both commonly accepted and very high levels (>120 mmHg).

In oncology, traumatology, and vascular surgery, the third subtype of ISPC is used, commonly known in Ukraine as "apparative lymphatic drainage" and "pneumomassage". This subtype is the main tool in the second line of treatment for long-term lymphedema, regardless of stage and localization. Also, therapeutic benefits can be expected regarding other pathology of the limb vessels, in particular, ischemia. For hardware lymphatic drainage, typical devices similar to those used for pressotherapy are used, with mandatory overlap of the chambers, often with a pressure gradient. Typical slow lymphatic drainage program modes. The construction of pneumatic cuffs (projection of the chambers) repeats the course of the lymphatic vessels, so there can be more variability in the cuff design than for pressotherapy, including asymmetric cuffs. Typical is a wide range of pressure adjustment, starting from small numbers (≈ 20 mmHg).

The fourth subtype of ISPC is called "intermittent pneumatic compression" (IPC) in Ukraine. This subtype is used in oncology, surgery, traumatology, neurosurgery, neurology, and therapy. It is optimized for thromboprophylaxis and can also be expected to have therapeutic benefits for other vascular pathologies, including ischemia. IPC devices have simple controls, are suitable for antiseptic treatment, and may have individual or disposable components. They typically have 1-3 chambers for localization on the feet and calf muscles, with typical cycles of fast compression and long pauses, 1-4 cycles per minute.

There may be also another experimental subtype of ISPC. This subtype is optimized for early-stage rehabilitation and is typically used for thromboprophylaxis and prevention of some consequences of hypodynamia, such as edema and muscle numbness. The main difference with this subtype is that it has portable devices with simple controls for private use. They are typically simpler in design than IPC prototypes, but still allow the wearer to walk with a pneumatic cuff on their leg and a control device attached to their waist, for example.

The last subtype of ISPC, which is traditionally called "volumetric (circumferential) pneumopressing" or VP in Ukraine, is used in general medical rehabilitation. It is a complementary tool of complex action (corrector, synergist, potentiator) in the comprehensive prevention, treatment, and rehabilitation of a wide

range of cardiovascular diseases and disorders, primarily peripheral vessels, some endocrine and metabolic disorders, traumatic and age-related changes in the musculoskeletal system, some mental disorders and pathology of the central, autonomic, and peripheral nervous system. Therapeutic benefits can also be expected for typical pathological processes such as edema syndrome, hypodynamia, intoxication, inflammation, chronic wounds, and so on. VP equipment typically has complex control or a program library. Programs may provide different combinations of active chambers and different directions of pneumatic massage wave propagation. Both slow and fast program modes are typical, close to the frequency of the heart rhythm. There may be variability in cuff design (8-12 chambers), typical asymmetrical cuffs, and asymmetrical programs.

It would be unnecessary to provide definitions for the described subtypes of ISPC, as they lack clear distinguishing criteria and can be interchangeable at times. It can be noted that the approach of VP is more universal and less specialized compared to others. However, the approach of pressotherapy has gained the most practical use and can be considered the "standard" at this stage of ISPC development. On the other hand, the approach of IPC is the most justified from an evidence-based perspective.

This classification helps users of medical equipment understand the differences between different types of ISPC therapy and their applications. The six described subtypes of ISPC therapy can be considered the main ones and provide a good overview. However, new technologies may emerge in the future that will be classified as new subtypes. For example, there is a cluster of pneumatic compression devices optimized for working with leg ischemia, which potentially can initiate a separate type of ISPC therapy. Contraindications and limitations may vary for different types of ISPC and should be considered separately.

Conclusion. In summary, pneumatic compression therapy is a family of therapeutic hardware technologies that utilize chambers with elevated air pressure. Intermittent sequential pneumatic compression is a type of local pneumatic compression therapy that is specialized for local or systemic stimulation of blood flow. It is a group of therapeutic methods used in various fields of medicine for the prevention, correction, or compensation of pathological conditions, the sanogenesis of which is determined by the ability of circulation, nervous regulation, and related processes.

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