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Editorial Open Access

Capillaroscopy Opens A Window to Look Inside

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Editorial

Capillaroscopy is an old but actual inexpensive imaging technique, used to examine, non-invasively and safely, the morphology of nailfold dermal papillary capillaries.

In the nailfold distal capillary row the dermal papillae run parallel to the surface of the nail, subsequently the capillaries of the distal row are visible in their whole length and appear as red, hairpin-shaped loops [1].

Johan Christophorus Kolhaus, first in 1663, had the idea to observe small vessels around the nails using a rudimentary microscope and about a hundred years later Giovanni Rasori (1766-1873), described the "inextricable knot of capillary loops" observed with a magnifying glass in inflamed conjunctives.

After almost another hundred years, Maurice Raynaud (1834-1881), with his studies on local ischemic damage, validated and promoted capillaroscopy as a fundamental imaging technique for the study of microcirculation.

In 2013 the power of the non-invasive nailfold videocapillaroscopy (NVC) technique, has been recognized for the early diagnosis of the scleroderma spectrum diseases, its predictivity and prognostic value, as well as its role as a tool for the therapeutic follow up. After more than 30 years of intensive investigation, capillaroscopy is now officially considered by the EULAR and ACR guidelines as both an essential and mandatory diagnostic tool for the classification criteria of systemic sclerosis. ACR/EULAR stated in the 2013 guidelines for classification criteria of systemic sclerosis (SSc):"Capillaroscopy is now widely used, and considering the value of magnified nailfold visualization in the diagnosis and management of SSc, these new criteria may encourage acquisition of this skill by physicians caring for SSc patients" [2].

Several different devices can be used for the capillaroscopic analysis: the widefield microscope, the dermatoscope, the video capillaroscope, the ophthalmoscope.The digital video capillaroscope, which consists of a microscope assembled with a digital videocamera, represents the gold standard for assessing or measuring capillaroscopic parameters. It not only allows low magnification, but also has the advantage of having sequential high magnifications which enable detailed observations of separate capillaries. Furthermore it allows direct contact with the nailfold, facilitating examination of patients with severe finger flexion contractures.

In order to evaluate capillaries, a drop of cedar oil has to be placed on the finger nailfold. A precise morphologic evaluation may be obtained by examining the fourth and the fifth finger of both hands due to the high transparency of the skin in these areas. However, all fingers from second to fifth should be examined, since early capillary alterations may be occasionally present in only a few digits [3].

During capillaroscopic examination, the following microvascular morphology should be observed and documented: tortuosiy, loop size, density, angiogenesis, capillary loss, microbleeding, subpapillary venous plexus and architectural structure. A normal capillaroscopic pattern, by qualitative assessment, is characterised by a homogeneus distribution of hairpin-shaped capillaries as a "comb-like structure", with a density of between 9 and 14 capillaries per mm. However, there is a wide intra- and inter-individual variability within normal population.

Clinicians often come across some difficulties in the final medical report of capillaroscopic examination because some findings may be considered between normal and pathological. A recent study by Ingegnoli et al [4] made an attempt to describe the heterogeneity of nailfold capillary parameters observed as an effort to define which capillary parameters should be considered part of the normal capillaroscopic pattern. Generally speaking, a capillaroscopic feature is considered an abnormal finding if changes are observed in at least two fingers [3].

Microvascular involvement in systemic inflammatory diseases has been well known since the 19th century. The detection of early microvascular changes occurring in some inflammatory connective tissue diseases is the most interesting feature of capillaroscopy for the rheumatologist.

Cold hands reflect an altered microcirculation, which is particularly common during winter and in women who are under emotional stress (Raynaud's phenomenon). However, in almost 20% of people who have cold hands, the cause isn't just functional and benign, but is the sign of connective tissue disease. In particular, systemic lupus erythematosus and systemic sclerosis might be clinically characterized, even in very early phases, by Raynaud's phenomenon.

How is the cause of cold hands or feet diagnosed? The best method is to test the levels of specific antibodies in the blood and to use nailfold capillaroscopy.

Capillaroscopic examination is crucial for the differentiation of primary and secondary Raynaud Phenomenon (RP) in rheumatic diseases, and also in differentiation between different forms of connective tissue diseases as well as for their early diagnosis. The detection of abnormal capillaroscopic patterns has high positive predictive value for the development of systemic rheumatic diseases.

The most important and well-defined capillary abnormalities are reported in people affected by systemic sclerosis (SSc).

Systemic sclerosis, also known as scleroderma, is a connective tissue disease that is characterized by sclerodermatous skin changes–a hardening of tissue due to increased collagen deposits; Raynaud's phenomenon–spasms of small blood vessels in response to cold or stress that cause color changes in fingers or toes, to obliteration of blood vessels (vasculopathy) leading to tissue death; and internal organ fibrosis–formation of excess tissue that scars organs.

In SSc and diseases of the scleroderma spectrum, mixed connective tissue disease (MCTD), dermatomyositis (DM) and polymyositis (PM) there is a prominent "scleroderma type" microangiopathy, which can readily be detected by capillaroscopy.

The majority of patients with clinically recognizable SSc show very characteristic combination of capillary abnormalities in the nailfold: presence of giant capillaries, hemorrhages, avascular areas and neoangiogenesis. This is called "the scleroderma pattern" and it is found in more than 90% of patients with overt SSc. According to the different proportions of the hallmark parameters where defined three patterns as "early", "active" and "late'' [5,6]. The "early" pattern refers to the presence of a few giant capillaries and hemorrhages along with normal-shaped capillaries and relativel well-preserved capillary distribution, without loss of capillaries. The "active" pattern is mainly characterized by the detection of several giant capillaries along with mild loss of capillaries. The "late" pattern is characterized by loss of capillaries with extensive avascular areas, ramified capillaries and disorganized vascular array. A semiquantitative rating scale was recently adopted to score each capillary abnormality (loss of capillaries and giant and micro-hemorrhages), in order to quantify the microvascular changes.

Peripheral microangiopathy in SSc can be easily recognised and studied early in the disease course by the detection of the most important capillaroscopic changes associated with the presence of this secondary RP. These microvascular SSc alterations appear in a dynamic progression and represent the morphological expression of the pathophysiology of the disease that, together with the microvascular damage, will result in tissue fibrosis. The major morphological parameters that characterize SSc are the giant capillaries and the asscіated micro-hemorrhages when they start to collapse, the loss of capillaries and the neo-angiogenesis [7].

Distinct morphological patterns on nailfold videocapillaroscopy and a significant gradual increase in the microvascular abnormalities are observed during the progression of SSc , and seem to reflect the evolution of the pathopysiology process.

Reduction in the number of capillaries in SSc patients as evaluated by nailfold-capillaroscopy are predictive of clinical complications.

Homogeneously enlarged microvascular loops are the earliest and most striking feature of secondary RP. The enlargements show a characteristic symmetrical shape involving both afferent and efferent branches of the capillary, or a horse-shoe shape. The detection of even a single giant capillary with an omogeneous increase in diameter > 50m at the level of nailfold should be considered a potential marker of microangiopathy related to an early SDS. The presence of homogeneously enlarged microvascular loop may be preceded and/or associated with irregularly enlarged microvascular loops that indicate an early partial damage of the capillary wall [8]. Patients affected by RP should always be examined by nailfold- videocapillaroscopy at least once a year as 15% of them after an average period of three years might develop systemic sclerosis.

Patients with RP as their only presenting symptom but who will develop other features of SSc in the future can be detected years before their clinically overt disease appears by simple screening using the combination of capillaroscopy and serology.

In contrast to SSc and diseases of the scleroderma spectrum family (SDS), the other Connective Tissue Diseases , such as systemic lupus erythematosus (SLE), Sjogren syndrome (SS) etc. do not have unique capillary patterns, may be normal, non specific or borderline.

Capillaroscopy is a non-invasive and safe technique that allows the detection and quantification of the early microvascular abnormalities that characterize secondary Raynaud's phenomenon. The well-established role of capillaroscopy for the early diagnosis of systemic sclerosis, its inclusion in the classification criteria, combined with its predictive value for clinical complications of the disease and its potential for monitoring disease progression and treatment response, makes nailfold capillaroscopy an important assessment in clinical practice and research. Capillaroscopy provides a unique window into the microcirculation and its application in diseases in which a microvascular component is suspected; it also may provide new insights into their physiopathology and natural history [8,9].

Microscopy of the nailfold capillaries is a irreplaceable diagnostic imaging technique in dermatology, rheumatology and angiology particularly as an important tool to distinguish between primary and secondary Raynaud disease while there is an increasing interest in its diagnostic usefulness in other sectors of Medicine as in the study of microvascular damage in a broad spectrum of pathologic conditions as for example vibration-induced pathology [10] or eating disorders [11].

Capillaroscopy, thus has the potential as simple inexpensive noninvasive and safe diagnostic tool, for an increasingly widespread application in medical practice, if performed by well-trained operators.

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