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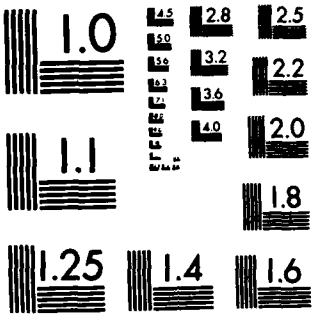

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Non-Invasive Evaluation of Raynaud's Phenonemon

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Introduction

The clinical syndrome we now call Raynaud's was initially described by Maurice Raynaud in the 19th century. Raynaud's disease or phenonemon is characterized by intermittent vasospastic attacks of the peripheral vasculature, accompanied by changes in color of the affected digits (white pallor, cyanotic blue, and deep red) precipitated by cold or emotional upset.[3,8,11,31] Vasospastic episodes are usually bilateral, involving the fingers or toes, and occasionally the ears and nose. These attacks may either be primary (idiopathic), and referred to as Raynaud's disease, or secondary to connective tissue or occlusive vascular disease, and referred to as Raynaud's phenomenon or syndrome. Raynaud's disease affects young women more than men,[8] and emotional instability is though by some to be present in a large number of cases,[31] although there is conflicting evidence.[15] Although the etiology of Raynaud's Disease is unknown, several theories exist including increased sympathetic tone, increased blood viscosity, metabolic disturbance, or local fault of the arteries.[4,7,16]

Differential Diagnoses

Criteria for diagnosis of idiopathic Raynaud's disease have been established[2,8,11] and are as follows: 1) intermittent vasospastic episodes excited by cold or emotion, 2) bilaterality, 3) gangrene absent or minimal, 4) absence of other primary causal disease, and 5) symptoms of at least 2 years. Laboratory studies are helpful in screening for connective tissue diseases, such as systemic lupus erythematosis (SLE), systemic sclerosis, rheumatoid arthritis, and mixed connective tissue disease. These tests include antinuclear antibodies, rheumatoid factor, sedimentation rate, and SLE latex. Occlusive vascular disease is also associated with Raynaud's phenomenon and includes thromboangiitis obliterans (most frequently seen in young males), arteriosclerosis

(elderly males), and thoracic outlet syndrome caused by cervical rib or abnormal scalenus anticus muscle.[4,31] Raynaud's phenomenon is also commonly caused by vibrating tools (pneumatic drillers, chain saws, and grinding wheels).[28]

Non-Invasive Evaluation

A careful history is elicited from the patient with emphasis on the presence of color changes in response to cold or emotional upset. Vasospastic episodes may often be elicited by immersing both hands in 15°C water[9,16] for 10-15 minutes. Immersing the right middle finger in cold water for 15 minutes may also differentiate normals from Raynaud's individuals. Jobe et al[14] found significant differences between normals and individuals with Raynaud's disease by immersing the right middle finger for 15 minutes in cold water at various temperatures. Differences at 5°C were only marginal. During 10°C immersion Raynaud's subjects showed a longer time to initiation of the hunting reaction (cyclic rewarming pattern), had lower mean digital skin temperature during immersion and had a lower amplitude of digital skin temperature of the hunting reaction. At 5°C seven of nine normals showed cyclic rewarming compared to four of eight Raynaud's subjects; at 15°C immersion Raynaud's subjects also had a longer time to initiate the hunting reaction, had less cyclic rewarming; and had lower recovery temperatures than normals. At 10°C eight of nine normals, but only three of eight Raynaud's subjects demonstrated cyclic rewarming, and at 15°C five normals but no Raynaud's subjects showed cyclic rewarming during immersion. Porter et al[22] also found significant differences between subjects with Raynaud's and normals after cold water immersion. Both hands were immersed in ice water for 20 seconds. Recovery time averaged 10 minutes for normal subjects and more than 30 minutes for Raynaud's subjects. Halpern et al[9] also found that digital temperatures for Raynaud's subjects were less than

normal after immersing both hands in 15°C water for 10 minutes. Thompson[29] found that immersing a finger in 0-2°C produced a hunting reaction in all Raynaud's subjects and that the time to initiate the hunting reaction was only slightly less than for normal subjects.

Evaluation of digital temperatures is also helpful in evaluating Raynaud's phenomenon. Several studies have shown that at warm ambient room temperatures (20-23°C), the digital temperatures of patients with Raynaud's disease are significantly less than digital temperatures of normal persons. Raynaud's patients in one study[15] had digital temperatures of 27.1°C in a 23°C room compared to 33.3°C for normals, and in a second study 29.5°C for Raynaud's patients and 31.5°C for normals.[14] Similar results were found by Peacock[19] in a 20°C room (22.0 - 24.2°C for Raynaud's vs 29.4 - 31.9°C for normals). Digital temperatures of Raynaud's patients in a cold room as expected, are also significantly below normal. Jobe et al[15] obtained average values of 10.5 -10.9°C after 10 minutes exposure to 0°C for Raynaud's patients compared to 13.3 -14.8°C for normals. These measurements were obtained by attaching a thermocouple to the dorsal aspect of each finger next to the nail bed with tape.

Significant differences in digital blood flow between subjects with Raynaud's disease and normals have been demonstrated using plethysmography. Using venous-occlusion, air plethysmography, Coffman and Cohen[5] found that patients with Raynaud's had significantly smaller total fingertip blood flow in both warm (34.3 vs 59.7 ml per 100 ml per minute) and cool (32.7 vs 13.2 ml) rooms than normal subjects. Flow studies were performed after one hour in a 28.3°C room and then repeated after one hour in a 20°C room, while the subject lay supine on a bed. Several of their patients had Raynaud's secondary to other diseases. Other studies have been carried out using a water-filled venous-

occlusion plethysmograph. Peacock[19] using a plethysmograph temperature of 32°C and 20°C room temperature, found significantly reduced blood flow in female Raynaud's patients as compared to female controls (2.9 vs 6.3 ml per 100 ml per min). Recordings were made after the subject lay supine for one hour. Using similar techniques Peacock[20] evaluated blood flow in Raynaud's patients and female controls with the plethysmograph at various water temperatures (17, 22, 27, 32, 34, 36, and 42°C). Although there was some overlap at higher temperatures, hand blood flows were less in Raynaud's patients than normals at all water temperatures.

Finger systolic pressure has also been used to evaluate differences between Raynaud's patients and normals during local cooling with a water perfused double-inlet-plastic cuff. After finger cooling to 20, 15, and 10°C, females with Raynaud's had significantly greater reduction in finger systolic pressure than normal females. The reaction in both Raynaud's and normals was enhanced by body cooling with a blanket perfused with 15°C water for 20 min. Combined finger and body cooling was effective in diagnosing Raynaud's.[18] Jahnsen et al[13] using similar procedures also found that Raynaud's patients had significantly lower finger systolic pressure at 20°C. Hirai[12] found differences in finger pressure before, during, and after local cooling between normals, patients with Raynaud's disease, and patients with Raynaud's secondary to Buerger's disease and scleroderma.

Ultrasonic flow evaluation is helpful in Raynaud's phenomenon.[27,32] Ulnar, radial and all digital arteries are examined, and the presence of an abnorman flow signal or absence of flow is evidnece of a disease artery. Ultrasound is also useful in differential diagnosis when thoracic outlet syndrome is suspected.

Several other techniques have received attention in evaluation of Raynaud's including infrared radiometry,[6] nailfold capillary microscopy,[10] and nerve-conduction velocity.[17]

General Therapy

For patients with Raynaud's secondary to other diseases, treatment of the underlying disease is of primary importance. At present there is no cure for Raynaud's disease, although there is no shortage of treatments. Medical treatment often involves avoidance of cold and emotional upset;[31] drugs such as vasodilator phenoxybenzamine,[21] 5-HT_2-receptor antagonist ketanserin,[25] calcium-channel antagonist nifedipine,[23] and intraarterial reserpine;[30] thyroid hormone;[24] plasmapheresis;[27] and sympathectomy.[3] Behavioral treatments have also been shown to be effective without the side effects or discomfort of drugs and surgery, and include biofeedback,[26] and Pavlovian conditioning.[15]

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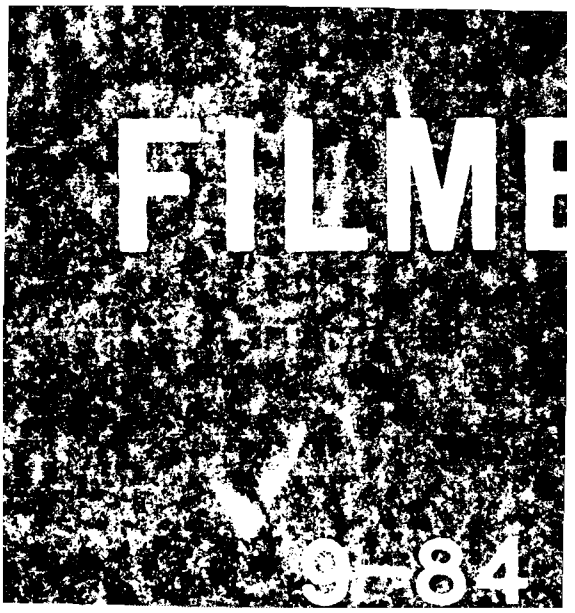
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