Cardiovascular Rehabilitation and Peripheral Vascular Disease

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Clinical Cardiologists works on diagnosis and treatment of pathologies of the human circulatory system. Lamentably, in many occasions we focus our efforts on the main organ (heart) and lose concentration on other sites of the arterial tree: Central Nervous System circulation and inferior members system.

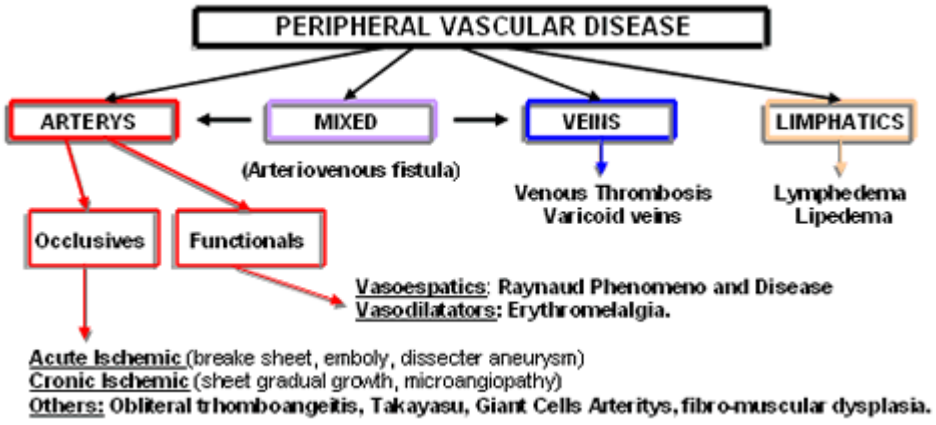
Neurologists peripheral circulation surgeons assume these area as primary importance.

Both sites just received secondary benefits of heart treatments (risk factors control) without a direct intervention.

The gold of these dissertation is make cardiologists meet a cardiovascular system region (different of cardiac), the peripheral vascular tree that feeds legs and which is affected by medical treatment disease in the most part of its evolution, they require surgery for revascularization or amputation on few and severe cases. There is in United States 8 to 12 millions of patients with arterial peripheral disease (with 4.3% of prevalence on 40's and 14.5% after 70's). [1] 4 to 5 millions of them show intermittent claudication and 150.000 are amputated by year with high perisurgical mortality rate due to co-morbidities [2,3].

In no surgical treatment we will focus on therapeutic physical exercise and risk factors modifications (cardiovascular rehabilitation) to prevent serious circulatory events (Primary prevention) or attenuate active risks factors and avoid new presentations (Secondary prevention).

Schema of Peripheral Vascular pathologies from inferior members:



We must having priority in the diagnosis of **chronic peripheral arterial occlusion**, an important **indicator** of **generalized arteriosclerosis**.

This pathology presents as etiology the Arteriosclerosis Risk Factors such arterial hypertension, sedentary,

dyslipidemias, smoking, Diabetes Mellitus, Obesity, Male sex, elevated homocisteinury, premature arteriosclerosis familiar disease.

The **symptoms and signs**, we could find are:

1) Intermittent claudication: pain, cramps; hip, thigh, and legs fatigue at walking, which starts at the same exercise level and relief when patient rests 5 minutes). In women, generates higher physical dysfunction [4,5].
2) Erectile dysfunction or sexual impotence.
3) Dry and scaly skin.
4) Deficient nails and hair growth.
5) Ulcers, necrosis and gangrene.
6) No edemas.
7) Absent or reduced beets.
8) Foot: dependent rubor, pallor on elevation (1 at 2 minutes).

Depending on the symptoms and alterations on the physical exam, there are **many classifications** of ischemic arterial vascular disease. The most famous is **Fontaine Classification**:

ESTADIO	CLINIC
I	Asymptomatic
II II a II b	Intermittent Claudication. without pain at resting, claudicates walking more than 200m without pain at resting, claudicates walking more than 200m
III	Nocturnal and resting pain.
IV	Necrosis and gangrene

Other classification, more used by **Vascular Surgeons** is the published by Ruther Ford and col. [7]

GRADE	CATEGORY	CLINICS MANIFESTATIONS
0	0	Asymptomatic homodynamic manifestations
I	1 2 3	Mild Claudication. Moderate Claudication. Grave Claudication.
II	4 5	Pain at resting Minor tissue loss, chronic ulcer, focal gangrene with diffuse ulcer
III	6	Mayor tissue loss extended behind transmetatarsic level unrecoverable foot functionality

Non invasive diagnostics

- **Ankle-brachial Index (ABI).** The ABI is defined as the ratio of the systolic blood pressure in the ankle divided by the systolic blood pressure at arm. The ABI is measured by placing the patient in a supine position for 5 min. Systolic blood pressure is measured in both arms, and the higher value is used as the denominator of the ABI. Systolic blood pressure is then measured in dorsalis pedis and posterior tibial arteries) by placing blood pressure cuff just above the ankle helped by a Doppler detector. The higher value is the numerator of the ABI in each limb. **Depending on the**

measurements we may determinate:

Normal 0.91 to 1.3.
Mild Obstruction 0.7 to 0.9.
Moderate Obstruction 0.4 to 0.69.
Severe Obstruction <40.
Poorly compressible ankle artery (calcification) >1.30.

In the cases of doubt diagnosis, is possible to sensitize the measurement performing a graded treadmill (looking for inferior members muscle fatigue or intensive pain with intermittent claudication.) and compare the values before and after the effort (if it is detected a fall between the measurements of ankle pressures >20mmHg the diagnosis is Intermittent Claudication.

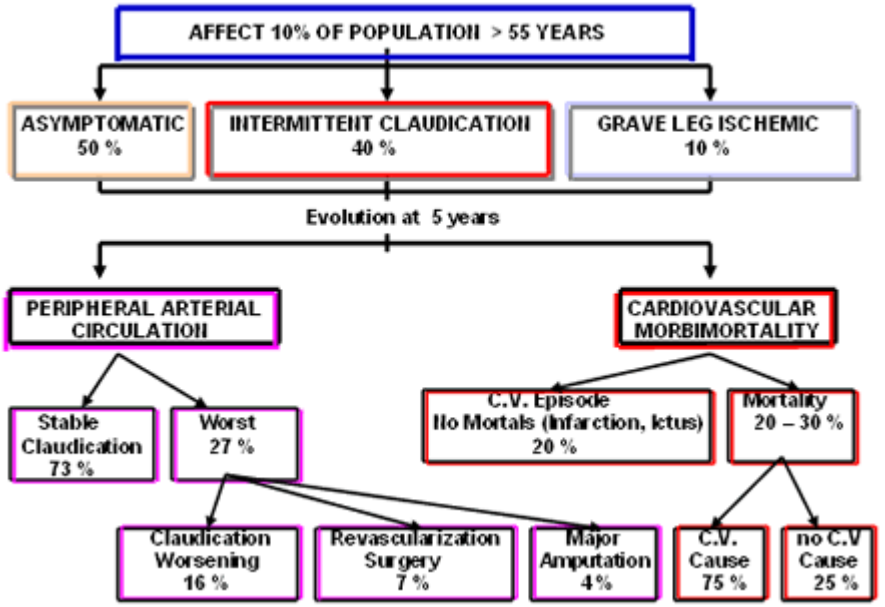
Ankle pressures values < 55 mmHg in non diabetics and > 70 mmHg in diabetics indicates the patient has important difficulty for soft tissues cicatrisation. There are many studies demonstrates that patients asymptomatic with ABI index £ 0.90 has increasing cardiovascular morbimortality. [8,9]. Associations between ABI and function were stronger than associations between leg symptoms and function. [10]

- **Magnetic Resonance Angiogram** (which is progressive replacing invasive methods but with high costs)
- **Ultrasonography** and **Doppler** with precise visualization of arteries and to analyze the wave shapes of the beets (which correlated with arterial pressure indicate diagnosis of the grade and severity of the disease, [11,3]; it is useful for to value therapeutic procedures with stents or revascularization.
- **Transcutaneus measurement of partial Oxygen pressure.**

Invasives diagnotics method
Selective Arterial Catheterization Angiography and radiologic contrast liquid **with or without image by digital subtraction** is essential to perform revascularization or amputation surgery.

All clinical valuations and complementary methods are performed to be able to **precise diagnosis and treat** in correct way depending on the disease evolution.

Ten years ago, Jeffrey Weitz and col. published data about changes on time of the population with chronic peripheral arterial disease. [12] Many Scientifics publications adapted schemes to represent this data:



By the certainty of which pathologies affects the inferior members cardiovascular system, and their

evolution, **there are two reasons for the importance of early diagnosis of peripheral vascular disease:**

First , to identify high risk myocardial infarction patients or acute stroke, and then reduce their morbimortality (comparing those patients with subjects without disease, they have mortality risk due coronary disease of 6.5, general cardiovascular general mortality 5.9, and mortality for all causes 3.1 [3] and half of them presents cerebral or coronary disease symptoms. [13]

Second, to eliminate the symptoms that cause lost of different grades of function, improving life quality and lack the possibility of amputation. [14]

Those explanations justify the planning and application of **Strategies of Prevention and Treatment**.

Modifications of the Cardiovascular Risk Factors (CRF)

- **Complete abandoning of Tobacco Habits** (patients who reduce the number of cigarettes by day, just compliance for short term, until emotional disturbs presents.) It may be necessary psychological therapy and fundamentally, generate a appropriate medical-patient relationship, explaining about the risks at shot and long term due to tobacco consume. It is a hard and big task for both, but may always be done. Smokers (men or women) has double or triple possibilities to develop intermittent claudications. [15] and by the quit of the smoking habit they will have better pain evolution on time [16] and long term permeability venous shunts. [17,18]
- **Adequate Diabetes Control,** in conjugation with anterior item, are the most important factors to develop peripheral vascular disease. In diabetes disease, vascular lesions are localized on femoral, popliteal and tibial's artery, those are diffuse and distal, associated to neuropathy in which, is less intermittent claudication; meanwhile, smoking and hypertension are associated to proximal disease, affecting abdominal aorta, iliacs an femorals, with focal lesions, without neuropaty and hard presentation of intermittent claudication. Diabetes specific treatment based on tree pillars: pharmacological therapy (oral hypoglycemic and/or insulin) + diet + medically controlled physical activity.
- **Combat obesity and excessive weight** which integrates the Metabolic Syndrome and potentials other risk factors, increasing sedentary tendency, higher joint exigencies and hard affectation of lymphatic and venous system.
- **Arterial pressure maintenance between normal limits** through low salt consume, physical activity and pharmacological therapy, if necessary.
- **Normalize Lipid panel** with diet, exercise and pharmacological therapy.
- **Antiplatelet Therapy** with aspirine, clopidrogel, ticlopidine, cilostazol, etc.
- Control other possible risk factors: elevated levels of Reactive C Protein, Fibrinogen, homocisteyn, and plasmatic viscosity.
- **Stress management** from cardiologist, and if necessary, psychotherapy.
- **Cardiovascular Rehabilitation (CR)** in all patients with CRF for development of peripheral vascular disease (and obviously cardiogenic).

Reviewing the Evolution of Peripheral Vascular Disease scheme, the addition of Intermittent Claudication patients and the patients which worsening on time, 89% of patients are in medical treatment and rehabilitation, 11% of patient which goes on surgery may receive an important treatment complement trough exercise. It is demonstrated the important role of cardiologist, specifically the ones specialized on CR.

The implementation of Physical Therapy on most of the patients who need CR is difficult because: a) low medical derivation rate, from specialists without own service on their center or no utilization of centers which count with it (mainly on women, old adults, whom needs to many exclamation of benefits). b) inadequate medical cover for this services and c) important geographic distance to capacitated medical

centers with this service. [19,20]. For those reasons, this therapeutic resource keeps sub estimated and consistently non indicated to patient population. The estimation is that 10 to 20% of myocardial infarct or revascularization surgery patients participate on this therapy. [19]

The low therapeutic application for medicals, do not take advantage from media communication about the benefits of CR an physical activity as valuable tool.

This situation is more discourage for peripheral vascular disease [21] even the existence of international normative recommending the therapy. [23]

How and when will we perform CR in those patients?
When we detect modifiable riskier patients. To perform CR **we must to value the evolution of the case**, evaluate old diagnosis methods of peripheral disease, look for circulatory pathologic manifestations from central nervous system or peripheral stroke sequel and cardiopathy evidence.

On other way, must detect born, muscle or articulations affectation from vertebral column, hips, legs, taking care with the altered sensibility threshold of diabetic patients. It may be important the consideration of other area specialist intervention. [22] Revascularizated patients has many possibilities to participate of CR, than Diabetic insulin-dependant patients or with low ABI index. [24]

We should determinate effort capacity and pain threshold by an exercise testing to set up the work level we'll indicate. Treadmill is more convenient than bicycle ergometer. To determine the initiation of mild, moderate or severe pain must develop protocols with soft levels increasing (1.0 mile/hour, increasing velocity every 2 minutes [25] or by Weber Protocol). In cases with important peripheral neuropathy, laying bike is indicated to lack patient falls or lesions. When both methods are lack to been developed, arm exercise test will be performed, at least, to determine myocardial energetic consume. We must evaluate existence of myocardial ischemia, arrhythmia (continuous ECG monitory) and Arterial Pressure performance on effort.

On rehabilitation session, will be indicated tree minutes level effort on treadmill which generate mild to moderate pain. Starting with 30 minutes session, gradually duration increasing to 50 minutes. Strength training are less effective than treadmill walking exercise. [26] CR developed at office is effective than the one developed at home [27,28] with more improving on peripheral circulation and neuromuscular coordination. [29,62]. On diabetic neuropathy patient is recommended to perform swimming, bike, sitting and lying exercises, without weight transportation instead slide strip, long walks or steps. [30] Diabetic patients had worst legs function [31].

Why to do CR on those patients? Since 1966, scientific bibliography shows benefits of this therapy. Exercise rehabilitation increased treadmill distance walked to onset of claudication by 134 % and to maximal claudication by 77 %, walking economy by 12 %, 6-minute walk distance by 12 % and maximal calf blood flow by 30 % after 6 month. [36] Four weeks later appear first results. [33] and after 12 weeks of intervention [34, 35]. Other authors shows good results [36,37,38,39,40,41,61,62], even, on patient without claudication [42] The improvement on patient functional status allow him to develop high energy request exercises, with social reinsertion and improving of auto esteem. Those patients which not receive therapy experiment diminution of physical activity, stability and legs circulation; as was demonstrated by Gardner and col. [44].

Which changes improves the functional status of patients on CR? Is wrong to believe that ischemic regions must experiment surgical revascularization therapy. This concept just reduce necrosis develop and amputation on severe cases (7% of patients). The improvement will be reached trough medical treatment and exercise. [45] Exercise optimizes the energy demand for oxygen extraction from arteries in legs.

It is demonstrated abnormal mitochondrial metabolism at legs skeletal muscles in peripheral vascular disease patients [46] which improves with exercises [47] accumulation of intermediates of oxidative

metabolism (acylcarnitines) [48] fall in oxygen saturation and longer recovery times in comparison with normal person [49,50]. Exercise improves endothelial dependant vasodilatation and blood circulation on legs muscles [51], Type I and II fiber, capillary density, reduction on IIb fiber and better muscular resistance. [52] After 6 month, fibrinolysis improves [53,43] Venous and lymphatic disease improve with exercise too.

Pharmacological therapy

Cilostazol: primary and secondary antiplatelet by phosphodisterase III with thrombosys and platelet activation inhibition. Reduce smooth muscle proliferation, increases legs artery circulation flow, reduces triglycerides and LDL, vasodilatation by lack calcium.

Generate a significant Absolute Claudicating Distance and Initial Claudicating increasing at 100mg/12h dose. Most frequently adverse event is: headache, diarrhea, peripheral edema and palpitations. [54] Contraindicated in grave congestive cardiac insufficiency.

Pentofiline: approved in 1984 by FDA to intermittent claudicating treatment. Improves plasticity of red cells, reduce fibrinogen, and platelet aggregation. Improvement of the claudicating beginning and absolute values. Otherwise, clinics benefits are not defined. [55]

Propinil-l-carnitine: it is not clear the mechanism for the improvement on walking distance. Dose 2g/day. [56]

Angiogenic Growth Factors: have shown preliminary success in patients with resting pain and ischemic ulcers. [63]

Angioplastic therapy and by pass surgery [57]

Indicated on:
- Incapacitating claudication that interfere on patient work and life style.
- Limb salvage in persons with limb-threatening ischemia as manifested by rest pain, nonhealing ulcers, and/or infection or gangrene.
- Vasculogenic impotence.

Amputation [57]

Performed if:
- Tissue loss has progressed beyond the point of salvage.
- Surgery is too risky because for patient general status.
- Short life expectancy is very low.
- Functional limitations diminish the benefit of limb salvage.

Treatment costs and life quality

Disease severity determines cost treatment. Holler and col. [58] showed that annual costs for medical assistance on Fontaine IIa status disease patient is 1792 euros, IIb status 2551 euros, status III 4356 euros and status IV 6225 euros. The costs of the in-hospital treatment 44.4%, drug 33.4%, care costs 6.7%, **rehabilitation 3.6%,** adjuvant 1.9% and indirect costs 9.67%. Other authors showed in-hospital CR short program with adequate cost – benefit rate. [59]

The expected gain in effectiveness achieved with peripheral By Pass surgery is small compared with the costs. Angioplasty performed whenever feasible was more effective than was exercise alone, and the cost-effectiveness ratio was within the generally accepted range. [60]

Conclusion

On peripheral vascular disease patients, CR helps to control CRF, because slow down severe disease evolution, patient develop high life autonomy, increases efforts level for claudication pain. Otherwise, is economic and reduces other intervention necessity. Low percentage patients need surgery or pharmacological therapy.

In conclusion, physician should apply this therapeutic.

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