DIODE LASER IN THE TREATMENT OF

CONGENITAL VENOUS MALFORMATIONS

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Abstract:

Introduction: Venous malformations belong to the group of low-flow vascular malformations. They are present at birth and grow progressively during childhood and puberty. Conventional treatment includes sclerosis and surgical excision as curative measures. The purpose of this study is to assess the usefulness of 1470nm diode laser, a technique applied to the treatment of varicose veins of the extremities resulting from valvular incompetence, as a therapeutic measure in congenital venous malformations.
Materials and methods: Twenty patients with simple venous malformations or associated with different syndromes were evaluated and selected as candidates for diode laser treatment in the Unit of Congenital Vascular Anomalies from the Pediatric Hospital (Hospital Infantil) La Paz. In all of them a diode laser device operating at a wavelength of 1470nm (Ceralas, Biolitec ®, Jena, Germany) was used, subsequently analyzing the results obtained with a mean follow-up of 6 months.
Results: Among these 20 patients, complete resolution was achieved in 16 and partial resolution in 4, in which the treatment must be repeated. In 4 of these cases, minor complications were registered which were referred or are in recovery phase.
Discussion: Diode lasers constitute a low cost and minimally invasive technique for the treatment of venous malformations. Current experience with diode lasers is reduced, but the results obtained are encouraging and are an invitation to expand its use to the rest of vascular malformations (lymphatic or arteriovenous).

Introduction:

The progressive advancement in the clinical and pathological knowledge of congenital vascular anomalies has allowed for progressing actively in their correct classification and nomenclature. In parallel, treatment outcomes have improved with a clear decrease in morbi-mortality and a significant increase in quality of life.

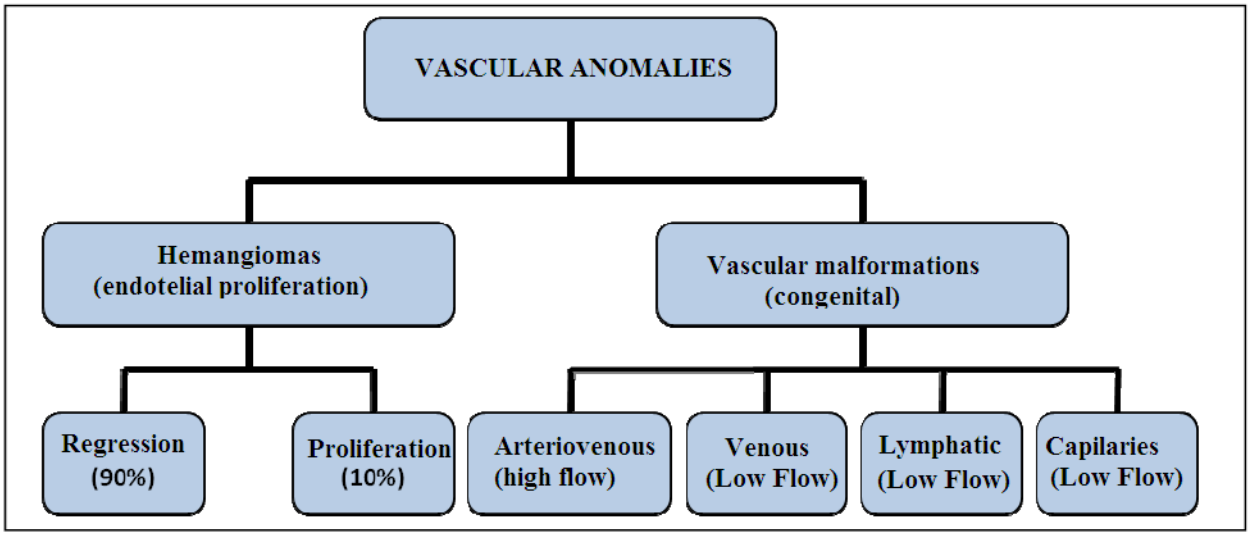
In the particular case of venous malformations, both pure and mixed or in the context of syndromes such as Klippel-Trenaunay or Blue Rubber Bleb Nevus, conventional usual treatment includes sclerosis and surgical removal as curative measures[1-5], while pressotherapy and the treatment of coagulopathies and pain remain as standard palliative treatment[6].

The use of lasers in many of its varieties (pulsed dye, Nd: YAG, CO_2 or fractional) has proven its unquestionable usefulness in superficial malformations in oral and genital mucosa[7-9]. For years, laser diodes have been used with increasing frequency in the treatment of varicose veins of the extremities as a result of valvular[10-13] incompetence and it may be well established that today it is on its way to becoming the treatment of choice[14,15]. Based on this experience, we have applied the concepts of treatment of acquired venous dilatation to the congenital venous dilatation in its multiple presentations.

Classification of vascular anomalies
Knowledge and understanding of vascular anomalies has been facilitated by the work of Mulliken and Glowacka[16], who treated them based on their clinical appearance and biological behavior; subsequently the International Society for the study of vascular anomalies in 1996 proposed their classification according to clinical, histological and physiological characteristics[17] resulting in two main categories of vascular anomalies: hemangiomas and vascular

malformations[18]. Hemangiomas are benign vascular tumors characterized by a rapid initial growth of endothelial cells and then a slow involution, while the term vascular malformations refers to congenital lesions consisting of dysplastic vascular channels without endothelial proliferation or spontaneous regression.

Table 1. Classification of vascular anomalies



Venous malformations are framed within the group of low-flow vascular malformations. They are present at birth and usually appear as plaques or blue non-pulsatile masses with progressive growth during childhood and puberty. Their most frequent location is the cranio-facial area (60% of them) and can also be found in the trunk and extremities[18]. Histologically, they are composed of networks of venous channels with variable communications with the physiological venous systems[19].

Endovascular laser:
The first publication on the use of endovascular laser dates from 1999[20], and its use has been progressively generalized, mainly in the field of acquired venous dilation in adult patients, but in recent years also in the case of congenital vascular anomalies in pediatric patients.

Endovascular laser ablation basically consists in the induction by laser energy applied directly from inside the vascular formation of a photo-thermal irreversible process, seeking complete occlusion of the treated vein in the case of its application to acquired venous dilation and, in the case of congenital, their photocoagulation, either total or partial.

Basic material for its use consists of an emitting source with applicators attached to fibers of different types (radial, spherical).

As to the different laser systems used in endovascular therapy, their main differences consist of their different wavelengths, because they seem to be the main discriminating factor of their therapeutic effects as well as their adverse effects. Among the most commonly used wavelengths are 810nm, 940nm, 980nm, 1064nm, 1320nm and 1470nm[21]. Generally, a longer wavelength (above 1000nm) produces more water absorption but less absorption by blood, especially hemoglobin, which in turn has therapeutic implications, since the desired effect is the direct action on the vascular wall by the absorption of interstitial water minimizing the photo-thermal effect on hemoglobin and other blood components. In the particular case of the 1470nm laser, used in clinical practice since 2006, it seems to be some balance between its rate of absorption by water and hemoglobin given the published studies, but the ideal wavelength is still under debate.

Among the main short-term adverse effects in adult patients with acquired venous dilation we can find bruising, local pain, slurring and phlebitis among the most frequents, and very rare, though described, cases of deep venous thrombosis (DVT), paresthesia, skin burns and pulmonary embolism[22]. In pediatric patients with vascular malformations pain, skin or mucosal necrosis, paresthesia and hypoesthesia and edema of the treated zone have been described as major adverse effects [14,15].

Materials and methods:

During 2010, 20 patients with congenital venous malformations have been studied and chosen as candidates for diode laser treatment at the Congenital Vascular Anomalies Department (Unidad de Anomalías Vasculares Congénitas) of La Paz´s Children´s Hospital (Hospital Infantil La Paz). Selection criteria were the following:

- Patients with severe superficial venous dilation in Klippel-Trenaunay syndrome with a permeable deep venous system (patient)
- Patients with diffuse phlebectasia of the upper limb (Bockenheimer disease) previously treated with sclerosis and surgery (1 patient)
- Extensive intramuscular isolated venous malformations (3 patients)
- Subcutaneous venous malformations (13 patients)
- Blue Rubber Bleb Nevus Syndrome (2 patients)

Figures 1 y 2 Diode laser application device (source and fiber)

Treatment objectives were:

- Minimizing surgery by decreasing the amount of incisions and intervention time
- Simplifying postoperative care
- Complementing additional previous treatments
- Reducing loss of red blood cells and the need for transfusions

In all patients, we have used a 1470nm wavelength diode laser unit (Ceralas, Biolitec, Jena, Germany) with 3 different types of fibers (radial 1mm, round tip 1mm and ultraslim 0,6mm) depending on the anatomy and hemodynamics of the malformation. All patients have been previously evaluated by echo-Doppler and angio-resonance or angio-CT and procedure has been carried out under general anesthesia in all cases with a time period ranging from 15 to 160 minutes.

By means of a mini incision, the selected fiber was introduced in the interior of the malformation and laser was applied on as much endothelial surface as possible, controlling emission of heat onto the skin. Cold has been applied in 1 case of very superficial malformation and no intraoperative echographies were done. Ischemia was used in treatment of distal malformations in limbs.

Figure 3 Application of diode laser in lingual venous malformation

Results:

Results after an average 6 month evolution show complete resolution in 16 patients and partial in 4, whose procedures will need to be repeated. Only 2 patients have needed transfusion of packed red blood cells.

Four complications have been registered: one moderate cutaneous necrosis which cured spontaneously after 2 weeks, 2 hypoesthesias at

the back of the foot and one mild deficit extensor at the 4th finger, all of them in recovery phase. In none of the cases, systemic complications were observed.

Discussion:

Treatment of congenital vascular malformations should be guided by the principles of modesty and humility, since healing, especially those that are high flow is hard to achieve. Therapeutic success in venous malformation approach is based first of all, on a profound knowledge of the physiopathology of each of its varieties and on tenacity and patience when carrying out selected procedures.

Pediatric patients are in this sense a little more complex to treat, since all treatments should be realized under general anesthesia, risks of intoxication by contrast iodine (hypotiroidism)[23] or by sclerosant (alcohol)[24] make the dose smaller and procedures repeated. Localization of congenital venous anomalies is frequently intramuscular or affects great extensions of skin[18], therefore surgery necessarily implies important aesthetic and functional deterioration which is only worth accepting if solution will be permanent, which is not frequent. For these reasons it is reasonable to study the exploration of new therapeutic options in depth, especially those that have been evaluated in adults, and to use that experience for the peculiarities of pediatric patients and their problems.

The 1470 nm laser diode has clearly superior efficiency in comparison to its predecessors[22,25,26]. The advantage of this procedure is not only its efficiency through its minimally invasive mechanism, but also it is complementary and non exclusive with the rest of the therapeutic options.

A reduction of the pathologic endothelial surface and therefore of the consumption coagulopathy, always contributes to the other treatments, as is easily demonstrated by the monitoring of the D-Dimer in analytic controls. In any case, caution is essential when evaluating results. Current experience is limited and long series of patients are necessary to help select ideal patients for optimizing results and minimizing complications.

Additionally, we are before a non-invasive low cost technique, which allows expanding its use in times of moderating healthcare costs, reducing hospital stays and postoperative complexity.

Figures 4 and 5 upper limb Diffuse Phlebectasia (Bockenheimer disease): pre and postoperative images.

Figures 5 and 6 Blue Rubber Bleb Nevus syndrome: Pre and post operative images.

Finally, the satisfactory preliminary experience is an invitation to expanding its use to the rest of the vascular malformations (lymphatic and arteriovenous) as well as its use in patients that do not accept transfusion of hemoderivatives.

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