Ultrasound-guided Intralesional Diode Laser Treatment of Congenital Extratruncular Venous Malformations: Mid-term Results

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WHAT THIS PAPER ADDS

At our center, laser ablation as a minimally invasive method has shown, over the short term, promise in the treatment of congenital extratruncular venous malformations. In this study, the results show that endovenous laser ablation is a minimally invasive treatment with the advantages of safety, effectiveness, and simplicity in ameliorating symptoms associated with venous malformations in appropriately selected patients.

Objective/Background: Over the short term, endovenous laser ablation (EVLA) has been found to be safe and effective for endovenous ablation in extratruncular venous malformations (EVMs). We report our experiences in percutaneous ultrasound (US)-guided treatment of congenital EVMs with respect to effectiveness and safety over the mid-term.

Methods: This was a retrospective analysis of a collected database of consecutive US-guided intralesional diode laser treatments of congenital EVMs (2007–2013). A consecutive series of 164 patients (86 women/girls [53%] and 78 men/boys [46%], aged 1.5–68.0 years [mean age 20.78 years]) were treated using EVLA for congenital EVMs at our institution. All of the patients were symptomatic. The primary outcomes for assessing safety were mortality and morbidity, including laser-related adverse events, thrombotic events, and important nerve or vessel injuries, and so on. Effectiveness was assessed according to reduction of the mass, the absence of pain, and technical success.

Results: One hundred and ninety procedures were undertaken in 164 patients, achieving a 100% immediate technical success rate. Most complications were minor and improved quickly, except in one patient, who suffered a peroneal nerve injury. Spot skin burn injuries occurred in one procedure (0.53%). Paresthesia in the treated area was noted after 15 procedures (7.89%). For complaints related to swelling, cosmetic outcomes, and pain, the clinical success rates were 65.71%, 68.97% and 97.74%, respectively. After a mean follow-up of 23.91 months, no patient suffering from pain, hemorrhage, or limited range of motion had returned with recurrent symptoms after initial successful treatment (resolved). Recurrence rates in patients with heavy sensation, swelling, and deformity were 6.89% (two of 29), 7.41% (two of 27), and 11.11% (one of nine), respectively. One hundred and twelve (59.00%) treated lesion areas were classified as "excellent", 59 lesions (31.00%) were "good", and 19 lesions (10.00%) were "fair" using duplex US imaging at the final follow-up visit.

Conclusions: EVLA is a minimally invasive treatment with the advantages of safety, effectiveness, and simplicity in ameliorating symptoms associated with EVMs in appropriately selected patients.

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INTRODUCTION

Venous malformations (VMs) are congenital, comprise two-thirds of vascular malformations, and are formed from venules and large veins. Based on the Hamburg Classification System,[1] congenital VMs are appropriately classified into extratruncular VM (EVM) or truncular VM using criteria that take into account the underlying anatomical, histological, pathophysiological and hemodynamic status of the defects, which are arise at different embryonic stages. The EVM

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Table 1. Baseline clinical and demographic characteristics of 164 patients treated with endovenous laser ablation.

EVMs	Limited	Infiltrating	Total
Sex (*n*)			
Male	17	61	78
Female	19	67	86
Age (y), mean	18.47	21.32	20.78
Lesion location (*n*)			
Shoulder	2	7	9
Chest and abdomen	2	9	11
Back	0	5	5
Forearm	6	12	18
Lower extremity	15	83	98
Foot	5	14	19
Hips	2	9	11
Perineum	1	7	8
Fingers	2	13	15
Temporalis	1	0	1
Symptoms and signs (*n*)			
Pain	21	112	133
Heavy sensation	9	68	77
Limited range of motion	2	9	11
Hemorrhage	0	6	6
Swelling	17	88	105
Deformity	2	27	29

Note. EVM = extratruncular venous malformation.

subtype is a histologically benign lesion that typically grows in size with the patient; it may undergo accelerated growth during adolescence, pregnancy, surgery, or trauma. The truncular subtype preserves the embryonic characteristics of the mesenchymal cells, along with the potential to grow and proliferate, resulting in a high risk of recurrence. Their specific biological characteristics make it the most difficult lesions to treat, posing a major clinical challenge.

The clinical manifestations of EVMs include venous stasis, ischemia, skeletal anomalies, coagulopathy, disseminated intravascular coagulation, and so on. Surgical resection remains the only solution for "cure" of EVMs; however, generally, it requires surgical excess with high morbidity (e.g., excessive blood loss, adjacent nerve damage, movement limitations, scars). Incomplete resection of the lesion will result in higher risks of recurrence.[2,3] Repeated foam sclerotherapy for the treatment of EVMs is not ideal. Because most vascular malformations have complicated venous networks with irregular lumens, it is difficult to control the dosage of sclerosing reagents owing to their progressive dilution and irregular distribution in the vessels. Thrombotic occlusion with mild endothelial injury caused by irritants has been associated with recanalization rates ranging from 1% to 15%.[4] Even worse, the irritants may enter into the systematic circulation during sclerotherapy and induce cardiovascular events.[5]

As a minimally invasive method, laser ablation has shown great success in the treatment of saphenous vein insufficiency and tributary varices. The fibrotic obliteration of the lumen caused by laser ablation has achieved an overall long-term closure rate of 94–97%.[6–9] Histological analysis has shown that the main damage occurs along the path of the laser's contact with the wall, implying that the primary mechanism of action of endovenous laser ablation (EVLA) is thermal injury caused by direct contact and by the heated bubbles of steam created.[10–12] It has also shown promise, over the short-term, in the treatment of congenital EVMs.[13]

In this study, a consecutive series of 164 patients (86 women/girls [53%] and 78 men/boys [46%]) being treated with EVLA for congenital EVMs at our institution from May 2007 to February 2013 were analyzed retrospectively. This article recounts our experiences with EVLA in the treatment of EVMs, and evaluates its efficacy and safety over the mid-term.

MATERIALS AND METHODS

Patient profiles and treatment procedures

We reviewed the records of all of patients who received laser ablation treatment. All of the patients signed informed consent forms, and the protocols of this study were approved by the ethics committee of the 9th People's Hospital. The clinical data of the patients are listed in Table 1, and a database was set up using a spreadsheet. Data included the extent of the lesion, different anatomical sites, the age of the patient, and the extent of clearance of the lesion as the treatment's end point. The main criterion for study inclusion was a diagnosis of EVM according to The Hamburg Classification System.

Inclusion criteria were as follows:

- lesions were visible on ultrasound
- lesions (size, anatomical location, or both) ranged widely, were dispersing or localized, or the patient was unwilling to undergo surgical treatment
- low-flow lesions, resulting in no change after conservative management
- declining quality of life for patients with swelling, pain and other symptoms.

Exclusion criteria included contraindications, such as fibrinogen levels <1.0 (normal range 2–4 g/L), or intolerance of anesthesia, and deep lesions not visible on ultrasound (US).

Pre-procedure patient care and anesthesia

For treatment planning, all of the patients had magnetic resonance imaging (MRI) of the affected areas, and only patients with US-visible lesions were selected for laser ablation. All of the patients were treated under general, epidural, lumbar, or local anesthesia.

Laser technique

Only the portions of the lesions visible on US were treated. For small, localized lesions, we attempted to treat the entire lesion in one session. For large and diffused lesions, only parts of the lesions, chosen by patient direction and visible protrusion of the swelling, were treated per session.