The Internet Journal of Surgery
Volume 3 Number 1

Technique Of Ultrasound-navigated Intralesional Nd:YAG Laser Coagulation Of Congenital Vascular Disorders

S Spendel

Citation

S Spendel. *Technique Of Ultrasound-navigated Intralesional Nd:YAG Laser Coagulation Of Congenital Vascular Disorders*. The Internet Journal of Surgery. 2001 Volume 3 Number 1.

Abstract

The treatment of voluminous hemangiomas or vascular malformations, particularly of the infiltrative type, is difficult and requires a combination of methods such as surgical excision, embolisation, laser therapy, sclerotherapy and magnesium spiking (1,2,3,4). Ultrasound- navigated intralesional Nd: YAG (Neodymium:Yttrium-Aluminium-Garnet)-Laser coagulation has been proven valuable, particularly in treating venous malformations of the infiltrating type.

INTRODUCTION

The treatment of voluminous hemangiomas or vascular malformations, particularly of the infiltrative type, is difficult and requires a combination of methods such as surgical excision, embolisation, laser therapy, sclerotherapy and magnesium spiking ([1,2,3,4]). Ultrasound- navigated intralesional Nd: YAG (Neodymium:Yttrium-Aluminium-Garnet)-Laser coagulation has been proven valuable, particularly in treating venous malformations of the infiltrating type.

MATERIAL AND METHODS

Ultrasound-navigated intralesional Nd: YAG laser coagulation was performed on 21 patients aged from 3 months to 28 years (mean age: 17,8 years) with cavernous hemangiomas or vascular malformations (Table). 12 patients had vascular malformations primarily of the venous kind, whereas arteriovenous components were predominant in 5 patients. In 4 children, an extensive hemangioma was the indication for intralesional laser therapy. All patients with hemangiomas underwent ultrasound (color-coded duplexsonography), patients with vascular malformations underwent additional MR- and MR-angiography. Laser coagulation is performed under general anesthesia.

Figure 1

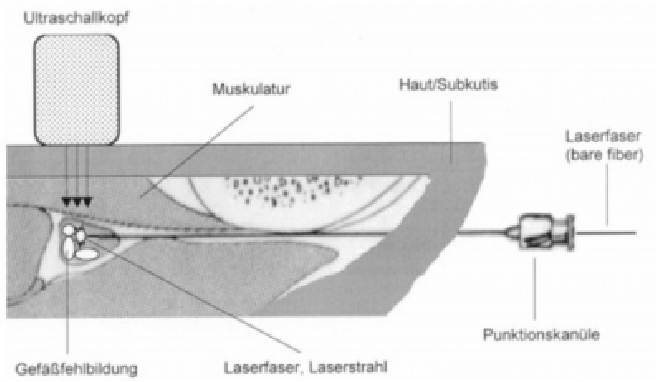
Table 1. Total energy applied after intralesional laser treatment

Patient	angeborene Gefäßfehlbildung*	Gesamtenergie (Joule)
1	H (Kind)	4230
2	AVM	5320
3	AVM	1450
4	VM	1110
5	VM (Kind)	6320
6	VM	4530
7	H (Kind)	780
8	VM	450
9	H (Kind)	1790
10	VM	1430
11	AVM	3420
12	VM (Kind)	2780
13	VM	5410
14	VM	3120
15	AVM	7570
16	VM	1250
17	H (Kind)	1910
18	AVM	5630
19	VM	2180
20	VM	1970
21	VM	1050

* H =Hemangioma, VM = Venous Malformation
AVM = Arteriovenous Malformation

Figure 2

Fig 1. Schematic illustration of ultrasound navigated intralesional Nd: YAG-Laser coagulation of a vascular malformation in the gluteal region



REQUIREMENTS AND TECHNIQUE OF THE ULTRASOUND-NAVIGATED INTRALESIONAL ND:YAG LASER COAGULATION

Requirements:

Instuments and Devices:

- Neodym-YAG-Laser (1064nm), Medilas, by. Dornier
- Bare fiber: 600 µm
- Ultrasound: ultrasound and color-coded duplexsonography (using a high resolution ultrasound system, 5 - 13 MHz; Duplex, Harmonic Imaging , Fa. Siemens)
- Steristrip to mark bare fiber after introducing the cannula
- Puncture cannula: 18G, 70mm, pvb – a SIMS trademark

Laserparameter:

- Laser power: 7 – 10 Watt
- Modus: continous wave (cw)
- Duration of laser application: up to a maximum of 170 seconds per region

TECHNIQUE

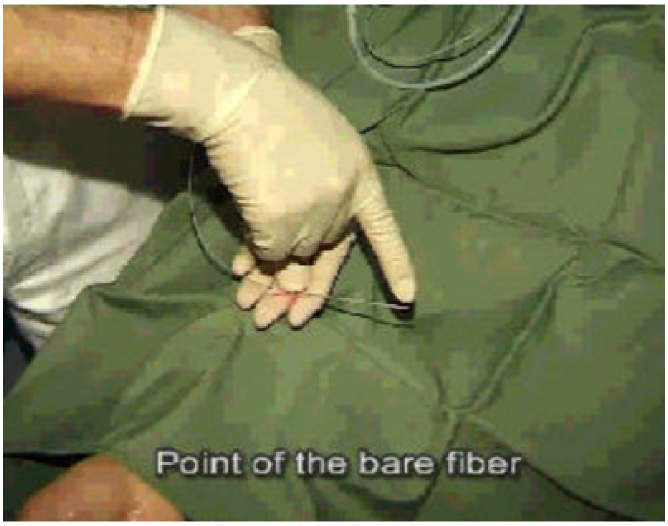
(click here to see video-clip)

1. Sonographic evaluation and documentation of vascular

malfromation immediately before laser treatment.

Figure 3

Figure 4



2. Puncture of skin and subcutis approx. 2 – 3 cm from the lesion.

Figure 9

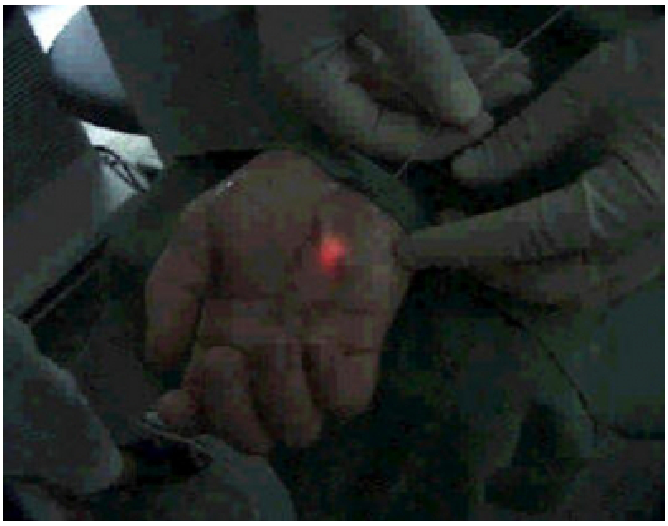
3. Placement of the cannula with the bare fiber into the lesion (not intraluminal!) under sonographic control (the bare fiber should not surpass the tip of the cannula during introduction of the cannula)

Figure 6

4. Placement of the bare fiber to the area marked by the steristrip which was applied befor laser treatment, in order to define how far the bare fiber surpasses the tip of the cannula

5. In case of subcutaneous location of the lesion, digital control of the position of the bare fiber from the outside so that the fiber tip is located at least 5 mm from the skin. In addition, the red helium-neon pilot beam can be helpful in checking the position of the bare fiber.

Figure 7



6. Sonographic control of the bare fibers position which should be located on the vessel wall of the vascular malformation.

Figure 8

7. Laser treatment under digital control – when crepitation as a sign of vaporisation of the laser fiber occurs, new ultrasound control of the bare fiber position is to be performed. Do not remove the bare fiber completely, the cannula should remain approx. 1 cm in situ.

Figure 10

Figure 11

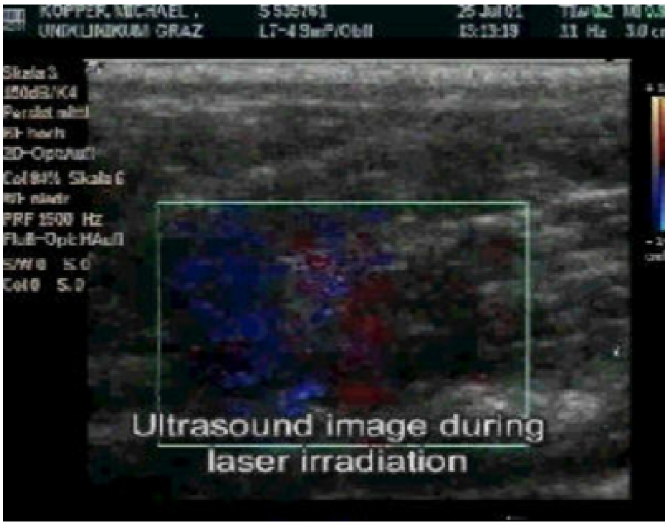


Figure 12

8. Renewed placement of the cannula (see number 3), to allow further laser treatment of other areas of the lesion.

9. Further procedure as described in numbers 4 – 7.

Figure 13

Figure 14

10. Pressure bandage

{image:14}

RESULTS

Three months after lasering, a volume reduction between 60 % and 80 % in hemangiomas (n=4), between 20% and 70% in venous malformations (n=12) and 0 % to 70 % in arteriovenous malformations (n=5) was achieved. With exception of necrosis in one patient which healed spontaneously, no further complications occurred.

DISCUSSION

Hemangiomas and vascular malformations differ in regard to form, size and clinical course and therefore require individual treatment schedules (1,2,5) Hemangiomas having a depth diameter greater than 2-3 cm, can not be sucessfully treated with a Nd:YAG laser (direct transcutaneous or transcutaneous laser treatment with surface cooling) due to the limited penetration depth of the laser beam. Intralesional or intravascular Nd:YAG laser therapy is more effective on voluminous hemangiomas (5,14). Already in 1982 Waldschmidt et al. (2) punctured hemangiomas and applied laser energy directly at the endothelium.

Vascular malformations, in particular those which infiltrate tissue (muscle or subcutis) are difficult to treat surgically since the resection of healthy tissue cannot be avoided due to missing boundaries (4). Especially when the vascular malformation is located deep in the subcutis or muscle, or at immediately adjoining nerves and functionally important tissues, ultrasound allows exact placement of the laser fiber to the vessel wall and continuous control of the fibers position (13). Healthy tissue can so be protected. The condition of vessels and perfusion can be analysed immediately after laser therapy with ultrasound. If necessary, a change in laser energy can be made in order to achieve the desired effect which is the occlusion in vascular malformations. (15,16).

Embolisation at the distal lower extremity is limited due to the danger of spasms with resulting ischemia (4). Intralesional Nd:YAG laser therapy can lead to volume reductions in the case of arteriovenous malformations with minor shunt behaviour or for predominantly venous or combined vascular anomalies. In literature, volume reductions between 50% and 90% using intralesional Nd:YAG laser therapy have been reported in treatment of hemangiomas and vascular malformations (1,3,5,6,7). A 70 % volume reduction was reported using MR-controlled intralesional Nd:YAG laser therapy on 16 patients with congenital vascular malformations (8). The results of the methods mentioned above are similar to ultrasound-navigated laser therapy (7,9,10,11,12,14).

Two different kinds of intralesional application are described: 1. Leaving the bare fiber and the cannula in the same position during the irradiation of the area. 2. Withdrawing the bare fiber and the cannula simultaneously at a speed of 1mm/sec. During laser treatment (2). We use the first technique, to add a specific amount of energy to a definitive area.

When using a metal cannula, the risk of overwarming of the cannula exists when the bare fiber doesn´t surpass the tip of the cannula adequately. For this reason, some authors use a teflon cannula. The advantage of the metal cannula lies in the placement within the lesion since the bare fiber does not have to be removed temporarily in this case.

CONCLUSION

Intralesional Nd:YAG laser coagulation is an effective and minimally invasive method for treatment of voluminous hemangiomas, in particular infiltrating types. This method is meaningful in combination with embolisation for treating arteriovenous malformations with large shunts. Ultrasound navigation of the laser fiber enables the exact placement and thus protects the surrounding tissue. The success of therapy can be controlled immediately after laser application by means of color-coded duplexsonography.

CORRESPONDENCE TO

Dr. Stephan Spendel
Klinische Abteilung für Plastische Chirurgie,
Universitätsklink für Chirurgie
LKH – Universitätsklinikum Graz
Auenbruggerplatz 29,
A-8036 Graz
Tel.: +43/316/-385-81215, 4685, Fax: +43/3112-7668
e-mail:stephan.spendel@kfunigraz.ac.at

References

1. Achauer B.M., C. Cheng-Jen , V.M. VanderKam, A. Boyko: Intralesional Photocoagulation of Periorbital Hemangiomas. Plast. Reconstr. Surg 103: 11 � 16 (1999)
2. Poetke, M., C. Philipp, H.P. Berlien: Ten years of laser treatment of hemangiomas and vascular malformations: techniques and results. In: Berlien,H.P., Schmittenbecher, P.P.(eds.): Laser surgery in children. Springer-Verlag, Berlin Heidelberg New York, pp 82-91, 1998.
3. Wimmershof, M.B., M. Landthaler, U. Hohenleutner: Percutaneous and combined and intralesional Nd.: Yag. Laser therapy for vascular malformations. Acta.Derm.Venereol 79/1: 71 - 73 (1999)
4. Loose, D.A.: Angiodysplasien. In: K. Alexander: Gef �rankheiten. Urban & Schwarzenberg, M�-Wien-Baltimore: 595 � 610 (1994)
5. Poetke, M., O. Bultmann, C. Phillip, H. P. Berlien: Hemangiomas and vascular malformation in early childhood. Z. Dermatol. 184/1: 40 � 47 (1998)
6. Berlien H.-P., C. Philipp, J. Waldschmidt, M. Poetke, G. M� Technique and Clinical Results of Nd: YAG Laser Treatment of Hemangiomas and AV-Malformations. Lasers in Medicine and Surgery, Suppl 4: 68 (1992)
7. Hackert I., Ch. Offergeld, P. Hoffmann, A. Scholz, K.-B. H�rink: Ultraschallkontrollierte interstitielle Nd:YAG-Lasertherapie angeborener Gef�rkrankungen. In: Hohenleutner U., Landthaler M. (eds) Operative Dermatologie im Kindes- und Jugendalter, Blackwell Wissenschafts-Verlag, Berlin Wien, pp123-127, 1997
8. Wacker, F. K., D. Cholewa, A. Roggan, A. Schilling, J. Waldschmidt, k. J. Wolf: Vascular lesions in children: Percutaneous MR imaging-guided intralesional Nd: YAG laser therapy.preliminary experience. Radiology 208/3: 789 - 794 (1998)
9. Hoffmann, P., Ch. Offergeld, K.-B. H�rink, I. Hackert, A. Scholz: Ultrasound guided intralesional Nd: YAG-laser therapy of cavernous hemangiomas. In: Anderson, R. (ed): Proceedings of Lasers in Surgery: Advanced Characterization, Therapeutics and Systems, Proc. SPIE 2395: 160 � 170 (1995)
10. Jacob, R., Th. Frommeld, J. Maurer, W. Mann: Nd: YAG laser therapy of vascular malformations controlled by duplex sonography. Ultraschall-Med 20/5:191 - 196 (1999)
11. Werner, J. A., S. Gottschlich, B. M. Lippert, B. J. Folz, G. Bandieramonte, ed., G. Bown-Stephen, ed., F. Chiesa, ed., J. Donnez, ed., H. J. Geschwind, ed, G. F. Lombard, ed., G. J. Muller, ed., H. D. Reidenbach, ed.: Realtime Ultrasonography as a monitoring technique for intralesional Nd.: Yag laser treatment of voluminous hemangiomas and vascular malformations. Photothermal therapies in medicine: San Remo, 4-6 September 1997 : Spie.Proceedings.series, 3193: 49 - 53 (1997)
12. Werner, J.A., B.M. Lippert, S. Gottschlich, B.J. Fleiner,

S. Hoeft, H. Rudert: Ultrasound-guided intralesional Nd:YAG laser treatment of voluminous hemangiomas and vascular malformations in 92 patients. Laryngoscope 108 (4 Pt 1): 463 70 (1998)
13. Uggowitzer, M., C. Kugler, S. Spendel: Sonographisch navigierte interstitielle Laserkoagulation ven Gef alformationen. Ultraschall in Med. 21: S42 (2000)
14. Spendel S, E-Ch. Prandl, M. Uggowitzer, Ch. Kugler, M.V. Schintler, A. Siegl, B. Hellbom, G. Schimpl, J.M. Mayr, E.G. Klein, M. Aschauer, E. Scharnagl: Ultrasound-navigated intralesional Nd:YAG laser coagulation of congenital vascular disorders. Med.Laser Appl. 16: 121 127 (2001)
15. Rhode, E., C. Philipp, H.-P. Berlien: Monitoring of Intralesional Laserinduced Thermotherapy (LITT) with Color-coded Duplexsonography (CCDS). In: SPIE Institutes for Advanced Optical Technologies. Vol.IS 13, Ed. M Rogan, Potter, V.2. (1995)
16. Offergeld, C., S. M. Schellong, W. G. Daniel, K. B. Huttenbrink: Evaluation of the benefit of color-coded duplex ultrasonographie for intralesional laser therapy of hemangiomas. Laryngo.Rhino.Otol. 77/6: 342 346 (1998)

Author Information

S Spendel, MD
Clinical Department of Plastic Surgery, Universitaetsklink fuer Chirurgie, LKH - Universitaetsklinikum Graz