External and intralesional photocoagulation of hemangioma in children with infrared diode laser

Ivan A. Abushkin, Valery A. Privalov, Alexander V. Lappa*, Evgeny L. Besshtanko
Medical Physics Center at Chelyabinsk State University
and Chelyabinsk State Medical Academy
Br. Kashirinykh 129, Chelyabinsk, 454021,Russia

ABSTRACT

Infra-red diode laser with wavelength 1060 nm was used for combined treatment of 163 children aged from 21 days to 13 years with 221 hemangiomas. For interstitial coagulation a power of 1.8-2 W and a power density of 5-90 J/cm^3 were used in continuous mode. For distant coagulation pulse mode was applied with pulse/pause duration 30-50/200-250 ms, average power 1.3-2 W, and power density 65-450 J/cm^2. 197 (89.1 %) hemangiomas were capillary, 7 (3.2 %) cavernous, and 17 (7.7 %) combined (combination of capillary and cavernous hemangiomas). The area of hemangiomas ranged from 6 mm^2 to 48 cm^2. For the majority (193, 87.3 %) of hemangiomas one session of photocoagulation was enough to achieve a good cosmetic effect. However, 28 (12.7 %) hemangiomas were treated repeatedly, 11 (5%) of them needed 4-7 sessions. In 8 children with cavernous and combined hemangiomas both distant and interstitial laser coagulation were used. In all, good or excellent results were obtained in 96,3 % of the patients. In 6 (3.7%) patients with extensive combined hematomas the considerable improvement was achieved.

Keywords: diode laser, hemangioma, children, laser coagulation, infra-red irradiation

1. INTRODUCTION

Hemangioma is a general and nonspecific term for benign tumour of vascular tissue, vascular nevus or vascular malformation[1]. Hemangioma affects 1.1-2.6 % of all newborns, and by the end of the 1st year of life this rate rises to 10.1% [2]. A single approach to the treatment of hemangioma in children hasn't been worked out yet. Taking into account that some hemangiomas, after the rapid growth during the first year of life, regress slowly during the following 5-7 years, some authors don't recommend active treatment but sometimes just observation. However, according to V.V. Shafranov et al.[3], just 6.7 % of hemangiomas can regress spontaneously. In spite of its benign nature, hemangiomas can have clinical features of malignant behaviour. Even tiny vascular tumours in newborns, especially in prematures, sometimes manifest rapid growth and reach great dimensions. The unfavourable clinical course of hemangioma without treatment is illustrated on Fig.1. Therefore we prefer the active tactic in case of a growing hemangioma in a child or hemangioma located on the face, and observation if hemangioma doesn't grow and shows signs of regression, e.g. appearance of more light areas on its surface.

The arsenal of the methods of treatment of hemangiomas available at present moment is quite large. It includes cryotherapy with liquid nitrogen or dry ice, SHF-therapy, short-focus roentgenotherapy, sclerotherapy, local and systemic hormone treatment, treatment with interferone, local compression, endovascular occlusion , and, finally, surgical excision of the lesion. Over the last few years, external (distant, non-contact) and interstitial (intralesional) coagulation with Nd:YAG and KTP-lasers has been successfully used in treatment of different hemangiomas[4-6].

Today the arsenal of lasers being used in medical practice increased with introducing surgical diode or semi-conductor lasers characterized by high economy, effectiveness, simplicity, and portability. However, technology of the diode laser treatment of different hemangiomas in children as well as clinical indications for this therapy haven't been worked out till now, and because of this we performed this study.

*lappa@csu.ru

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The aim of the work was the study of efficiency of the infra-red diode laser in complex treatment of various hemangiomas in children.

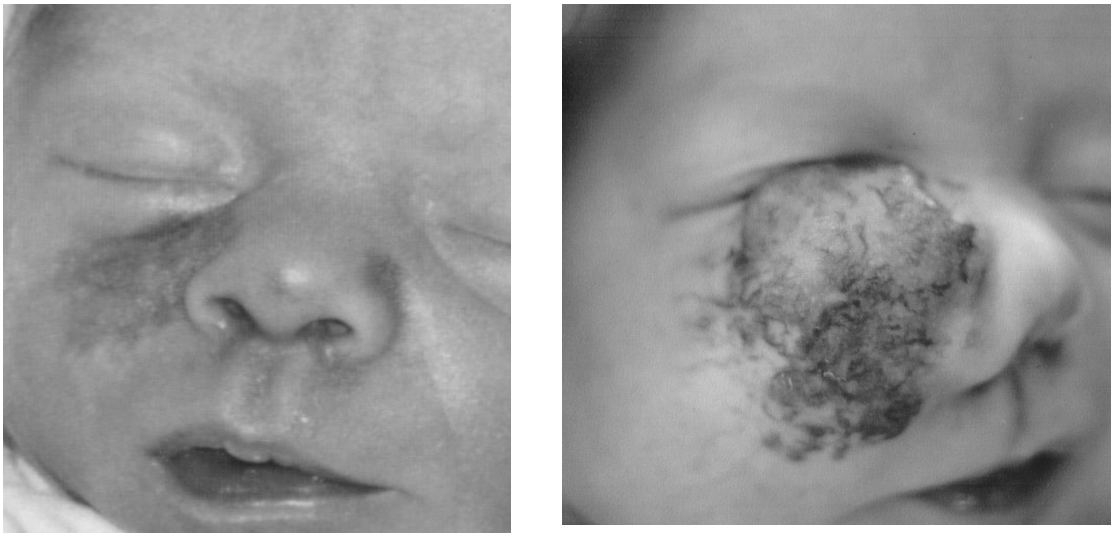


Fig.1. The unfavourable clinical course of hemangioma without treatment, patient C.

2. MATERIALS AND METHODS

The diode laser with a wavelength of 1060 nm was applied. The energy of laser radiation was delivered by an optical fiber 0.6 mm in diameter with a flat tip. The device was used in a pulse and continuous modes.

For interstitial coagulation the continuous mode was used with an average power of 1.8-2 W. The coagulation was stopped when the surgeon felt hot but not burning warmth with his finger near the working end of the lightguide. After achieving this heating, the lightguide was moved to the next zone, thus, the whole hemangioma volume was heated. The power density was 5-90 J/cm^3. During interstitial coagulation we didn't wait for the whitening of the skin because of the risk of necrosis.

In case of distance coagulation, the pulse duration was 30-50 ms, the pause was 200-250 s, with an average power of 1.3 - 2 W. The criterion of the coagulation duration was the slight whitening of the skin, the power density being 65-450 J/cm^2. The lightguide was positioned at right angle to the surface exposured. The distance between the working end of the lightguide and the surface of hemangioma was 2-3 mm.

During both interstitial and distance laser coagulation, we avoided the overlapping of zones of exposure or repeated exposure of the same zone to prevent overheating of the tissues.

During the period from August, 2001 till October, 2004 we have treated 163 children aged from 21 days to 13 years with a total number of 221 hemangiomas. 197 (89.1 %) hemangiomas were capillary, 7 (3.2 %) cavernous and 17 (7.7 %) combined (combination of capillary and cavernous hemangiomas). The group of capillary hemangiomas also included a small number of stellate hemangiomas. The majority of patients, 105 (64.4%), were treated during the first 6 months after birth, including 40 children (24.5 %) during the first 3 months. The age distribution of children with hemangiomas is shown on Fig.2.

The number of girls was 2 times greater than boys, 112 (68.7 %) and 51 (31.3 %) respectively. The area of hemangiomas ranged from 6 mm^2 to 48 cm^2. The hemangiomas were situated mainly on head and neck, 111 (50.2 %); 68 (30.7 %) of them on the face. On the extremities 57 (25.8 %) hemangiomas were located, including 6 (2.7 %) on the fingers. 40 (18.1 %) hemangiomas were located on the trunk and 13 (5.8 %) on genitals and perineum (Fig. 3).

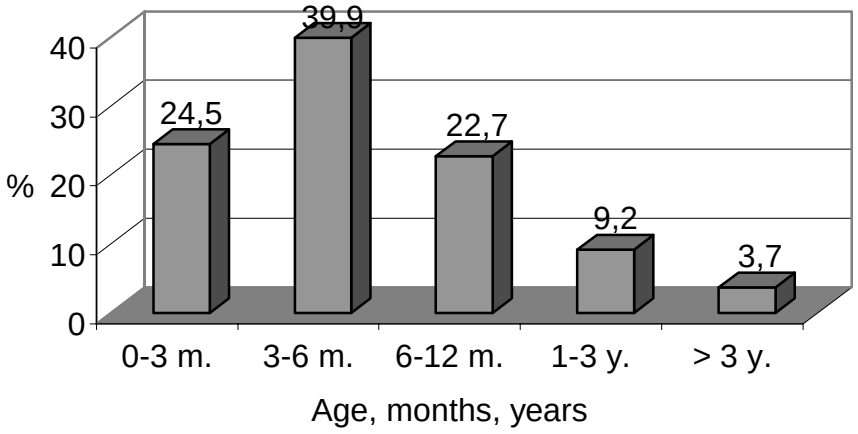


Fig.2. Age distribution of children with hemangiomas

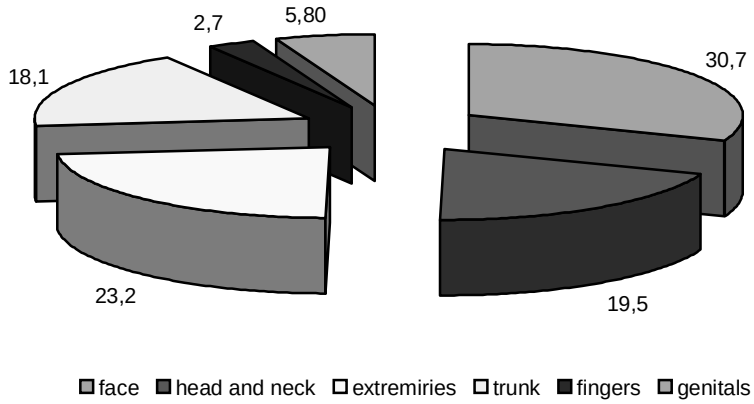


Fig.3. Localization of hemangiomas

In 4 children (1.8 %) hemangiomas were complicated by ulceration. In this cases previous conservative treatment including hyperbaric oxygenation was not effective.

For the majority (193, 87.3 %) of hemangiomas, one session of photocoagulation was enough to achieve a good cosmetic effect. However, 28 (12.7 %) hemangiomas were treated repeatedly, 11 (5%) of them demanded 4 to 7 sessions. These were simple hemangiomas with the large area and cavernous or combined ones. In treatment of 3 (1.4 %) combined hemangiomas photocoagulation was added by local hormone therapy, introduction of “Kenalog-40” in the cavernous part of the lesion in the 4 mg/kg dosage.

In 8 children with cavernous and combined hemangiomas, both external and intralesional photocoagulation were used.

Laser coagulation in little kids was performed under general anesthesia. In elder children we used local anesthesia with Lidocaine.

3. RESULTS AND DISCUSSION.

First, a blister filled with serous liquid developed after external coagulation. Later a scab formed. The wound healing under the scab was painless, dry and didn't demand much care. In the majority of cases the scab existed about 2 weeks. The cicatrice after distant coagulation was delicate and didn't differ much from the normal skin. On Fig. 4 a simple hemangioma of the face before and after treatment is shown.

Fig.4. A simple hemangioma of the face before and after treatment.

The cicatrice after cryotherapy with dry ice was more rough. Fig.5 depicts a capillary hemangioma of left gluteal region after treatment with dry ice and subsequent distant laser coagulation. A hypertrophic cicatrice after cryotherapy with dry ice and a delicate one after laser coagulation are clearly seen.

a b

Fig.5. A capillary hemangioma of left gluteal region after cryotherapy (a) and distant laser coagulation (b).

In cases of hemangioma's localization in complex anatomic regions (eyelids, genitals etc) the fine laser beam afforded to perform a precise coagulation of the lesion without damaging surrounding tissues. Fig.6 presents a capillary hemangioma of the clitoris region before and just after distant laser coagulation.

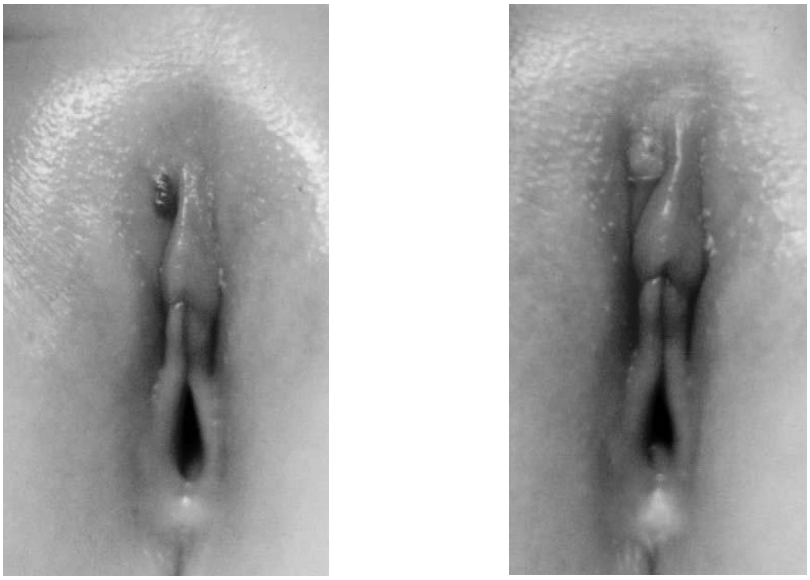


Fig.6. A simple hemangioma of the clitoris region before and just after distant laser coagulation.

Laser coagulation of ulcerated hemangiomas included the treatment of the angiomatous tissue and the ulcer surface as well. In these cases the ulcer also healed under a scab and totally epithelized.

When hemangioma was located on the scalp the pulse mode of laser let us leave the hair bulbs intact and keep the hair. Fig.7 shows a capillary hemangioma, and Fig.8 a combined hemangioma of the scalp before and after coagulation.

Fig.7. A simple hemangioma of the scalp before and after coagulation.

Fig.8. A cavernous hemangioma of the scalp before and after coagulation.

A combination of external laser coagulation and intralesional introduction of Kenalog-40 led to complete recovery in 3 cases of combined hemangiomas. The disadvantage of local use of Kenalog-40 is the forming of a visible pit due to developing of subcutaneous fat defect, which makes cosmetic result worse. A combined hemangioma of the chest wall before and after laser coagulation added by local introduction of Kenalog-40 is shown on Fig.9. The pit in the chest wall is seen.

Fig.9. A combined hemangioma of the chest wall before and after laser coagulation added by local introduction of Kenalog-40.

After interstitial coagulation the structure of hemangiomas substantionally changed over the following 3-4 weeks. The lesion grew less in volume and became denser. Fig.10 illustrates the gross impression of the surgically removed hemangioma, previously subjected to interstitial laser hyperthermia.

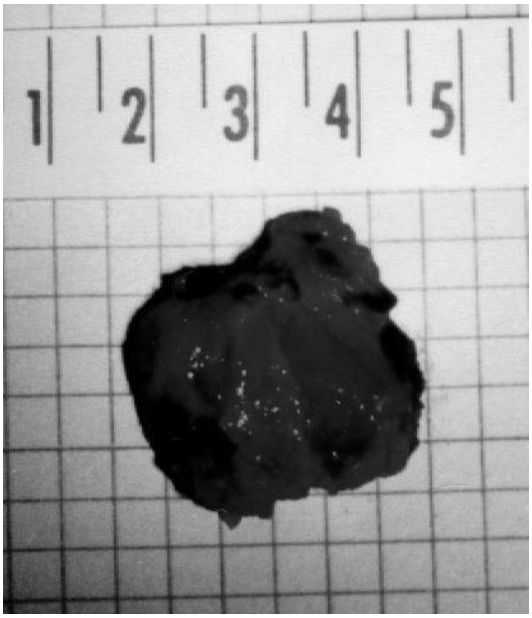
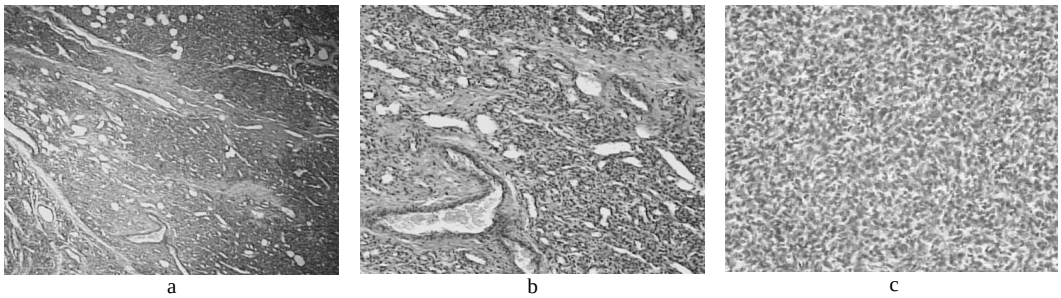


Fig.10. The gross impression of the surgically removed hemangioma, previously subjected to interstitial laser hyperthermia.

Hystological structure of removed cavernous hemangiomas that had been previously subjected to photocoagulation resembled capillary hemangioma. The structure of hemangioma became more dense, multicellular. Vascular spaces became narrow or absolutely non-observable because of proliferation of endothelium and fibroblasts. Sites of larger vascular formations were surrounded by tissue with signs of fibrosis. There were collapsed cavities with irregular outlines, filled with endothelium and surrounded by fibrous connective tissue. On the whole, the tumour structure became mosaic, what probably was a result of two processes: proliferation of fibroblasts and of endothelium. Fig.11 shows the general mosaic microscopic picture of the cavernous part of hemangioma (a) and areas with prevalence of proliferating fibroblasts (b) and endothelium (c).



a b c

Fig.11. Microscopic sample of a cavernous hemangioma after intralesional laser coagulation: general view (a), an area with prevalence of proliferating fibroblasts (b), area with prevalence of proliferating endothelium (c). Stained with hematoxylin-eosin.

These two processes contributed to substantial and rapid solidification of the tumour, but the considerable decrease of its volume took several repeated sessions of interstitial coagulation with an interval of 4-5 weeks, which dramatically prolonged the course of treatment. However, the solidification of the cavernous part of hemangioma cardinally eased its surgical excision due to reduction of bleeding and simpler separation of the tumour from the surrounding tissues.

Simultaneous distant laser coagulation led to the disappearance of the capillary part of hemangiomas followed by the forming of delicate whitish scar tissue. These bleached integumentary tissue areas were successfully applied for local skin grafting after surgical excision.

Since the single intralesional coagulation didn't reduce the tumour volume, but caused the transformation of cavernous part of hemangioma, we didn't perform repeated coagulations to reach the maximal reduction of the tumour. After both distant and interstitial laser treatment, solidification of hemangioma and whitening of its surface, we didn't wait for the tumour's involution, but performed surgical excision of the remaining tumour and skin grafting with local tissues. Such an approach considerably accelerated the treatment of cavernous and combined hemangiomas in 4 children and led to good and excellent results concerning both radical tumour excision and cosmetic effect. Fig.12 depicts the combined hemangioma of the nose initially, after distant and intralesional coagulation and after its excision and skin grafting.

a b c

Fig.12. Combined hemangioma of the nose initially (a),
after distant and intralesional coagulation (b) and after its excision and skin grafting (c).

4 (1.4%) hemangiomas were excised after preliminary distant and intralesional photocoagulation with an excellent cosmetic result

4. CONCLUSION

All in all, the excellent or good result was achieved in 157(96.3 %) patients. A significant improvement was achieved in 6 (3.7 %) patients with large combined hemangiomas. The use of infra-red diode laser in treatment of various hemangiomas in children, both independently and in combination with other methods, is reasonable and can be recommended to wide use in clinical practice.

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