Endovascular Laser Treatment of Venous Malformation in Children

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Objective: *To review the results of endovascular laser treatment of venous malformation in pediatric age group.*
Material and Method: *Retrospective review of children with venous malformation treated with endovascular laser from January 2010to December 2014 was conducted. The demographic data, natural history of disease, operative technical problem, postoperative results and complications of the patients were collected and assessed.*
Results: *There were 4 patients included in the study. The average age was 6.86 years. The presenting symptoms varied from asymptomatic, visible mass or large vessels to bleeding mass and pain on walking. There was no intraoperative complication. Post-operative follow-up at 2-6 months showed complete remission in all patients. One patient had partial recurrence and underwent complete surgical removal.*
Conclusion: *Endovascular laser treatment was effective in the treatment of venous malformation. Associated vascular malformation and venous insufficiency were commonly found. Recurrent venous malformation lesions after treatment are usually small and easier to remove.*

Keywords: *Endovascular, Laser, Children*

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Venous malformations are malformation of veins. This can be only one tortuous or elongated vein or many groups of veins along truncal or peripheral body distribution. The majority of venous malformation can be detected in childhood. Many treatment options can be used for the treatment such as surgery, alcohol injection, bleomycin injection, and laser[1,2]. Endovascular laser was a modality used to treat varicose vein with impressive results[3]. The authors report the results of endovascular laser treatment of venous malformation in pediatric age group.

Material and Method

Retrospective review of children with venous malformation treated with endovascular laser from January 2010 to December 2014 was conducted. The endovascular laser treatment protocol for tortuous or elongated vein begins with a color-flow Doppler ultrasound exam to confirm the venous malformation. Subsequently a guide wire was inserted into the target vein under ultrasound guidance, followed by the insertion of an introducer sheath. Additionally, an optical fibre carrying the laser energy was advanced through the introducer sheath. A tumescent anesthetic solution was injected into the soft tissue surrounding the target venous malformation along its entire length. Finally the laser (Nd-YAG, QCW mode, pulse width 300 ms, frequency 100 Hz) was radiated at a power of 20-25 Watt while the laser fibre and the introducer sheath were gradually pulled back along the length of the target venous malformation at a speed of a few millimetres per seconds. The desired linear endovenous energy density was 100-200 J/cm. At the completion of the operation, a color-flow Doppler ultrasound was used to confirm the disappearance of the target venous malformation. After the procedure, compressing bandage was applied to reduce postoperative pain, bleeding, venous thromboembolism, and recurrence. As for the group of venous malformation we used needle with sheath introducing into the lesion via the venous lake. The fibre optic was introduced along the sheath after needle withdrawal. The Nd-YAG laser (QCW mode, pulse width 600 ms, frequency 100 Hz) was radiated at the power of 5 Watt. The end point was the sensation of the skin over the lesion becoming warm. The demographic data, natural history of disease,

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operative technical problem, postoperative results and complication of the patients were collected and assessed.

Results

There were 4 patients (1 boy and 3 girls). The average age was 6.86 years (7 months to14 years). The presenting symptoms varied from asymptomatic, visible mass or large vessels to bleeding mass and pain on walking. All patients with tortuous or elongated veins had associated vascular anomalies (3 capillary malformations, 1 bleeding veno-lymphatic nodule) and had associated perforator vein incompetence. Preoperative imaging showed no deep vein thrombosis in all 3 patients with tortuous or elongated vein. The other had lesions at the forehead which needed no preoperative venogram or MRI to evaluate the deep vein thrombosis. Endovascular laser therapy was done in all 4 patients. Three patients with tortuous or elongated veins had intraoperative ultrasound confirmation of obliteration ofthe target veins. There was no intraoperative complication. Post-operative follow-up at 2 to 6 months (average 3.83 months) showed complete remission in all patients. The patient with venous malformation at the forehead had partial recurrence (1/3 of the previous size) at 4.5 months post laser therapy. The lesion was surgically removed without complication.

Discussion

Endovascular laser is a treatment modality for the treatment of varicose veins[4]. Considering some venous malformation has dilated or ectatic vein, the endovascular laser can be used as a treatment option in this type of venous malformation.

During endovascular laser radiation, the temperature raises more than 50°C[5], both cells and extracellular structure proteins such as collagen denature at 50 to 60°C[6-11]. The blood vessels become thrombosis and occluded. Possible mechanisms leading to vein wall heating including direct light absorption[12,13], heat diffusion to vein wall by haemoglobin and water[13,14], heat conduction by direct laser probe to the vein wall[13,15], and gas bubble-mediated vein wall heating[6,15]. Following the injury to the vein wall and vessel thrombosis, chronic inflammatory process begin including chemotactic and migration of neutrophils, macrophages, and fibroblasts[16-18]. Obliterative remodelling resulting in fibrosis and permanent occlusion of the vascular lumen which lasts up to several weeks[7].

Haemoglobin and water can absorb light at the wavelength ranging from 810 to 1,500 nm[19]. Absorption energy turns to thermal and diffuse to the vein wall. Nd-YAG laser has the wavelength of 1,064 nm which is effectively absorbed by haemoglobin and water that were media within the venous malformation lumen. Thus Nd-YAG laser is suitable for endovascular laser radiation as a treatment for venous malformation.

Tumescent anesthetic solution injected surrounding the target have many benefits. First, it provides anesthesia. Second, it compresses the target venous malformation and maximizes the laser's effect on the vein wall. Third, it separates target venous malformation to the surrounding structures including nerve and skin. And finally, it acts as a thermal sink, which reduces peak temperatures in perivenous tissue.

All patients with tortuous or elongated vein had associated capillary malformation at the nearby area. Venous insufficiency was found in all patients and emphasized the importance of additional investigation such as Doppler ultrasound or venogram.

The short term (within 6 months) reported occlusion rates for treatment of varicose greater saphenous vein were 93.7 to 99%[20,21]. Venous occlusion rate at 2 years follow-up were 93.7 to 97.8%[20,21]. In the presented study, complete remission was found in 100% in the average 3.83 months follow-up. Recurrence was not found in the patients with tortuous or elongated veins. Moreover bandage compression dressing after laser treatment may be an important physical factor in addition to photo and biochemical process discussed above. The patient with venous malformation at the forehead had complete remission at 2 months however had partial recurrence approximately 1/3 of the previous size at 4.5 months after the procedure. Compression bandage was not used and this might be the cause of recurrence of the lesion. However, the recurrent mass was smaller than initially and much easier to remove.

Major adverse events were reported at 0.63%[22]. These included deep vein thrombosis, skin burn, pulmonary embolism, nerve damage and wound infection. The authors had one superficial necrosis of the skin due to thermal injury. The wound was healed with textural change. Sensation of temperature of the overlying skin during operation is important in avoiding this complication.

Conclusion

Endovascular laser treatment was effective in the treatment of venous malformation. Associated

vascular malformation and venous insufficiency were commonly found in children with tortuous and elongated vein. Elastic bandage was an important physical factor to prevent recurrence. Recurrent venous malformation lesions after treatment are usually small and easier to remove.

What is already known on this topic?

Endovascular laser treatment was a modality of treatment of vascular lesion.

What this study adds?

Endovascular laser treatment can be used to treat pediatric venous malformation.

Endovascular laser treatment can reduce size of a vascular lesion to help surgical excision easier.

Potential conflicts of interest

None.

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ผลการรักษาหลอดเลือดดำผิดปกติแต่กำเนิดด้วยเลเซอร์

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วัตถุประสงค์: ภาวะผิดปกติแต่กำเนิดของเลือดดำเป็นภาวะที่พบได้ในทางกุมารศัลยศาสตร์ การรักษามีได้หลายรูปแบบได้แก่การผ่าตัด การฉีดแอลกอฮอล์หรือยาเคมีบำบัดเข้าไปในก้อนและการใช้เลเซอร์มีรายงาน การใช้เลเซอร์รักษาภาวะหลอดเลือดดำผิดปกติตั้งแต่กำเนิดในผู้ป่วยผู้ใหญ่ได้ผลดี ผู้นิพนธ์รายงานการรักษาภาวะผิดปกติของหลอดเลือดดำโดยใช้เลเซอร์ในเด็ก

วัสดุและวิธีการ: เก็บข้อมูลย้อนหลังในเด็กที่เป็นภาวะผิดปกติของหลอดเลือดดำแต่กำเนิดและทำการรักษา โดยใช้การยิงเลเซอร์เข้าในหลอดเลือดดำตั้งแต่ เดือนมกราคม พ.ศ. 2553 ถึง เดือนธันวาคม พ.ศ. 2557 ข้อมูลที่เก็บประกอบด้วย ข้อมูลทางระบาดวิทยา การดำเนินโรค เทคนิคการยิงเลเซอร์ภาวะแทรกซ้อน ผลลัพธ์จากการยิงเลเซอร์ และภาวะแทรกซ้อนจากการยิงเลเซอร์

ผลการศึกษา: มีผู้ป่วย 4 คน อายุเฉลี่ย 6.89 ปี อาการที่นำมาจะหลากหลายตั้งแต่ไม่มีอาการ เห็นก้อนหรือเส้นเลือดขนาดใหญ่ จนถึงเจ็บที่ก้อนเวลาเดิน ไม่พบมีภาวะแทรกซ้อนระหว่างการทำผ่าตัด รอยโรคหายไปทั้ง 4 คนในช่วง 2-6 เดือนหลังผ่าตัด มีผู้ป่วย 1 คน มีรอยโรคกลับเป็นซ้ำบางส่วนและรักษาโดยการผ่าตัด

สรุป: เลเซอร์เป็นอีกวิธีการรักษาภาวะเส้นเลือดดำโป่งพองแต่กำเนิดในเด็ก ผู้ป่วยอาจมีภาวะลิ้นหลอดเลือดดำผิดปกติร่วมด้วยการยิงเลเซอร์ยังเป็นการช่วยลดขนาดของก้อนเส้นเลือดดำที่โป่งพอง ซึ่งสามารถรักษาต่อไปได้โดยการผ่าตัด