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·临床研究·

单次光动力治疗后极部孤立性小病灶脉络膜血管瘤后黄斑形态及视功能变化

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[摘 要] **目的** 观察单次光动力治疗(PDT)对波及黄斑的后极部孤立性小病灶脉络膜血管瘤(PSCCH)黄斑形态和视功能变化的影响。**方法** 回顾性自身对照研究,选取2014年1月至2019年1月在我院接受PDT的11例PSCCH患者为研究对象。根据手术前后患者眼底彩色照相(FP)、眼底荧光血管造影(FFA)、吲哚青绿血管造影(ICGA)、眼部B超、光学相干断层扫描(OCT)检查结果,评价患者治疗前后最佳矫正视力(BCVA)、黄斑中心凹下视网膜厚度(FSRT)、瘤体基底最大直径和厚度的变化。所有患者均接受单次PDT治疗。术后随访1~24个月。**结果** 所有患者术后瘤体缩小,瘤体厚度从术前(2.318±0.725) mm降低到术后瘤体数据不可测,瘤体部位视网膜下液吸收,渗出性脱离减轻,中心凹形态恢复正常。FSRT由术前(876.09±483.74) μm降至术后(201.9±62.6) μm,差异有统计学意义($P<0.05$)。BCVA从术前的(0.27±0.33)增加到(0.35±0.40),差异有统计学意义($P<0.05$)。无患者发生治疗相关并发症;随访期间未见患者肿瘤复发。**结论** 单次PDT治疗PSCCH可以缩小瘤体,恢复黄斑形态,稳定视功能。

[关键词] 单次光动力治疗;小病灶;脉络膜血管瘤;形态;功能

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Changes of macular morphology and visual function in choroidal hemangioma with isolated small lesions after single photodynamic therapy

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Abstract: Objective To observe the changes of macular morphology and visual function in post pole small circumscribed choroidal hemangioma (PSCCH) by single photodynamic therapy (PDT). **Methods** A retrospective self-controlled study was performed in 11 patients

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[12] Steger B, Romano V, Biddolph S, et al. Femtosecond laser-assisted lamellar keratectomy for corneal opacities secondary to anterior corneal dystrophies: an interventional case series[J]. Cornea, 2016, 35(1): 6-13. doi:10.1097/ICO.0000000000000665.

[13] Li S, Wang T, Bian J, et al. Precisely controlled side cut in femtosecond laser-assisted deep lamellar keratoplasty for advanced keratoconus[J]. Cornea, 2016, 35(10): 1289-1294. doi: 10.1097/ICO.0000000000000962.

[14] Smedowski A, Tarnawska D, Orski M, et al. Cytoarchitecture of epithelial inflammatory infiltration indicates the aetiology of infectious keratitis[J]. Acta Ophthalmologica, 2017, 95(4): 405. doi:10.1111/aos.13363.

[15] Kam KW, Yung W, Li G, et al. Infectious keratitis and orthokeratology lens use: a systematic review[J]. Infection, 2017, 45(6): 1-9. doi: 10.1007/s15010-017-1023-2.

[16] Knyazer B, Krakauer Y, Baumfeld Y, et al. Accelerated corneal cross-linking with photoactivated chromophore for moderate therapy-resistant infectious keratitis[J]. Cornea, 2018, 37(4): 1. doi:10.1097/ICO.0000000000001498.

[17] Cheung AY, Sarnicola E, Eslani M, et al. Infectious keratitis after ocular surface stem cell transplantation[J]. Cornea, 2018, 37(11): 1. doi:10.1097/ICO.0000000000001690.

[18] 邓文容,张 燕. SBK术中不同冲洗方法对弥漫性板层角膜炎的影响[J]. 局解手术学杂志,2014,23(1):96. doi:10.11659/jjssx.1672-5042.201401044.

[19] 袁建树,王 骥,文 丰,等. 他克莫司对真菌性角膜炎患者移植手术后免疫排斥的影响[J]. 中华医院感染学杂志,2018,28(4):582-584. doi:10.11816/cn.ni.2018-173124.

[20] 秦 勤,陈 晖,李一壮,等. TICL植入术在矫治圆锥角膜深板层角膜移植术后屈光不正中的临床应用[J]. 中华实验眼科杂志,2016,34(2):137-142. doi:10.3760/cma.j.issn.2095-0160.2016.02.009.

[21] 胡卫萍,林 琳,周宏伟,等. 浙北地区197例真菌性角膜炎感染特征分析[J]. 中华医院感染学杂志,2018,28(9):1327-1329. doi:10.11816/cn.ni.2018-173082.

[22] 孙振蕊,丁 琳. 新疆地128例角膜炎临床分析[J]. 眼科,2017,26(2):143-144. doi:10.13281/j.cnki.issn.1004-4469.2017.02.017.

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with PSCCH who underwent PDT in our hospital from January 2014 to January 2019. According to fundus photochromy (FP), fundus fluorescein angiography (FFA), indocyanine green angiography (ICGA), B-mode ultrasound, and optical coherence tomography (OCT), changes of the best corrected visual acuity (BCVA), foveal subretinal thickness (FSRT), maximum diameter and thickness of the tumor were evaluated. All the patients received PDT one time, and they were followed-up for 1 to 24 months. **Results** Postoperative tumor shrinkage was observed in all patients, and the thickness of the tumor was reduced from (2.318 ± 0.725) mm to no data can be measured. The subretinal fluid was absorbed, the exudative detachment was relieved, and the foveal morphology returned to normal. The FSRT was reduced from (876.09 ± 483.74) μm to (201.9 ± 62.6) μm, with statistically significant difference ($P < 0.05$). The BCVA of 11 patients increased from (0.27 ± 0.33) to (0.35 ± 0.40), and the difference was statistically significant ($P < 0.05$). None of the patients had treatment-related complications. And there was no recurrence of the tumor during the follow-up period. **Conclusion** A single PDT for the treatment of PSCCH can reduce the tumor volume, restore the macular morphology, and stabilize the visual function.

Keywords: single photodynamic therapy; small lesion; choroidal hemangioma; morphology; function

脉络膜血管瘤(choroidal hemangioma, CH)是一种罕见的良性、血管性、错构瘤性脉络膜肿瘤。依瘤体波及的部位、范围大小和病理特征将脉络膜血管瘤分为孤立性脉络膜血管瘤(circumscribed choroidal hemangioma, CCH)和弥漫性脉络膜血管瘤(diffuse choroidal hemangioma, DCH),临床以 CCH 多见[1-6]。CCH 的治疗方法包括激光光凝(laser photocoagulation, LP)、经瞳孔热疗法(transpupillary thermotherapy, TTT)、质子束疗法(proton beam radiation, PBT)、外照射放疗(external beamradiotherapy, EBT)和立体定向放射疗法(stereotactic radiotherapy, SR)[7-14],但上述方法可引起不可逆的视功能损害。玻璃体内注射抗血管内皮生长因子(anti-vascular endothelial growth factor, anti-VEGF)对脉络膜血管瘤治疗作用尚不确定[15]。

单次光动力治疗(photodynamic therapy, PDT)是由光能激发光敏剂后,选择性引起病变局部光化学反应,使病变组织变性萎缩,对正常组织的破坏降至最小来达到治疗目的。PDT 对脉络膜血管瘤内皮细胞损伤由单线态氧介导,引起血管瘤萎缩,从而减少渗漏和相关视力丧失[16-24]。无论是单纯 PDT 或 PDT 联合治疗脉络膜血管瘤,其临床疗效参差不齐,目前 CCH 治疗尚无统一规范和临床共识[21-33]。波及黄斑的后极部孤立性小病灶脉络膜血管瘤(post pole small circumscribed choroidal hemangioma, PSCCH)是临床少见的脉络膜血管瘤类型,目前还缺少针对 PSCCH 患者 PDT 后黄斑形态和视功能变化的临床观察。本研究聚焦于单次 PDT 对 PSCCH 的疗效,观察 PDT 前后黄斑形态和功能的改变,以寻求 PDT 治疗 CCH 的最佳适应证和预后因素预测,指导临床实践,使患者获得最大视功能。

1 资料与方法

1.1 临床资料

我院 2014 年 1 月至 2019 年 1 月收治 29 脉络膜血管瘤患者,经眼科检查、眼底彩照(fundus picture, FP),B 超,最佳矫正视力(best corrected visual acuity, BCVA),眼底荧光血管造影(fundus fluoresceinangiography, FFA)、吲哚菁绿血管造影(indocyanine green angiography, ICGA)、光学相干断层成像(optical coherence tomography, OCT)、眼部 B 超、彩超及 MIR 检查,有 11 例确诊为 PSCCH,其中男 7 例,女 4 例,年龄 31 ~ 56 岁,平均 47.8 岁。患者发现患眼视觉异常到就诊时间为 5 d至 8 个月。视力采用小数视力表记录,患眼 BCVA 从手动到 1.0,平均 0.27。瘤体部位黄斑中心凹下视网膜厚度(foveal subretinal thickness, FSRT)最低311 μm,最高 1 825 μm,平均 876 μm。瘤体基底厚度最低 1.1 mm,最高 3.0 mm,平均 2.2 mm。CCH 小病灶界定:瘤体基底厚度≤3.0 mm,瘤体基底最大直径≤6 PD。

1.2 治疗方法

术前检测患者血压正常,排除脑梗死、心肝肾功能不全等疾病,采用 YHM-05-DUA/62A 眼科 PDT 激光(波长 689 nm)治疗机,安装后测试激光发射正常,检查静脉输液泵可正常使用。术前充分扩瞳,实施表面局部麻醉,患者采取坐位,静脉注药前再次仔细核对患者的 FFA、ICGA 和光学相干断层成像(optical coherence tomography, OCT)显示的病灶范围与黄斑区动静脉血管的距离,确定激光治疗范围的大小,选择照射光斑大小。根据患者身高、体质量值,用固定的公式计算出患者用药量,再用 5% 葡萄糖注射液稀释光敏剂药物(维替泊芬)至 30 mL,用特定的输液泵(syringepump SP 6000)匀速推注光敏剂至患者肘静脉,同时启动激光治疗仪计时,于注射后第 15 min 时进行患眼激光治疗。瘤体部位治疗选择改良的 PDT 参数:多光斑,小直径(3.5 ~ 5.0 mm),照射时间 83 s,激光能量 75 J/cm,光斑之间可相互重叠,覆盖瘤体边缘10 μm。病灶光斑 3 ~ 8个,平均 5 个照射光斑覆盖瘤体。治疗过程中尽量避开或保留视网膜小动脉,PDT 1 次。术毕嘱患者避光

3 d,术后1个月、3个月、6个月、12个月、24个月复查。

1.3 观察指标

通过OCT测量黄斑区视网膜厚度,眼部B超测量瘤体基底最大直径和厚度,以评估治疗前后波及黄斑的瘤体局部形态变化,通过BCVA来评估治疗前后视功能变化。

1.4 统计学方法

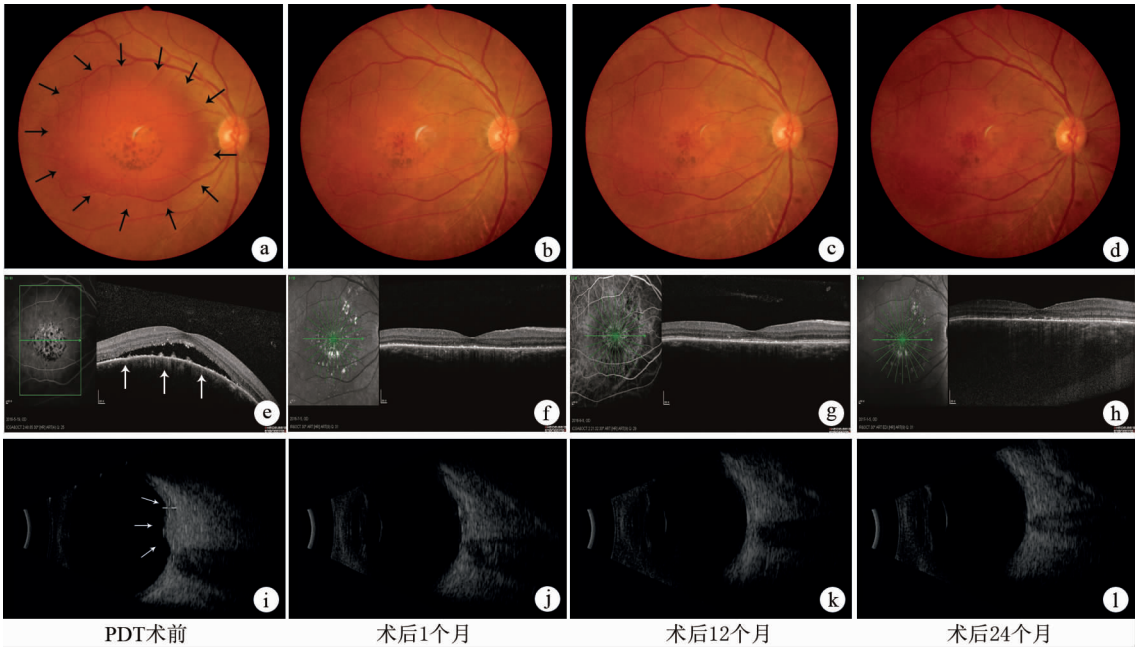
所有数据采用SPSS 20.0分析软件,数据描述采用均值±标准差($\bar{x} \pm s$)表示。治疗前后对比采用t检验,以$P<0.05$为差异有统计学意义。

2 结果

所有PSCCH患者PDT治疗一次完成,术中患者生命体征平稳,无皮肤瘙痒、哮喘等过敏反应发生,无头昏,无肢体和注射部位疼痛,无激光照射相关并发症,无眼局部损伤(角膜晶体激光损伤等)。术后随访1~24个月,无视网膜裂孔、视网膜和脉络膜脱离、视网膜动脉阻塞、视网膜缺血等相关并发症,随访24个月未见患者脉络膜血管瘤复发。治疗后所有患者的瘤体缩小,瘤体厚度从术前(2.318±0.725)mm降低到术后瘤体数据不可测,瘤体部位视网膜下液吸收,脱离复位,中心凹形态恢复。FSRT由术前(876.09±483.74)μm降至术后(201.9±62.6)μm,差异有统计学意义($P<0.05$)。患者BCVA从(0.27±0.33)增加到(0.35±0.40),差异有统计学意义($P<0.05$),PDT治疗后患者视觉质量提高。患者治疗前后瘤体基底容积参数变化显著,差异具有统计学意义($P<0.05$),见表1。治疗前后PSCCH患者眼底、B超改变和OCT瘤体形态变化见图1。

表1 11例PSCCH患者临床资料及瘤体形态和功能参数变化

患者	性别	年龄(岁)	病程(d)	视网膜厚度(μm)		肿瘤基底 长×宽×高(mm)		最佳矫正视力	
				治疗前	治疗后	治疗前	治疗后	治疗前	治疗后
1	女	51	90	731	218	9.8×3.3×1.2	–	数指/眼前	数指/10 cm
2	男	54	180	704	224	8.9×2.4×1.8	–	0.2	0.6
3	男	52	240	1 050	300	4.8×3.0×2.7	–	0.1	0.1
4	男	31	30	1 825	112	15.4×6.1×3.0	–	手动	手动
5	女	54	30	361	264	未记录	–	0.7	0.8
6	男	54	90	1 036	214	9.0×1.9×1.7	–	0.15	0.3
7	女	44	60	1 277	112	9.5×4.5×3.0	–	0.2	0.4
8	男	45	30	311	241	6.8×3.3×2.6	–	0.6	1
9	男	56	90	558	198	9.1×4.6×2.9	–	数指/眼前	数指/眼前
10	女	49	5	1 385	219	未记录	–	0.06	0.1
11	男	36	180	399	119	4.7×4.2×1.1	–	1	1



a~d:眼底彩图;e~h:黄斑区OCT结果;i~l:B超显示瘤体影像变化

图1 单次PDT治疗PSCCH患者眼底影像变化

3 讨论

波及黄斑的小病灶 CCH 单次 PDT 的依据及优势:肿瘤瘤体新鲜,不伴随纤维细胞增生和胶质细胞增生,无巨噬细胞或色素上皮细胞侵入、无纤维化等继发改变,瘤体血管内皮细胞与光敏剂足量结合后激光容易穿透瘤体,使局部激光效应和药物结合最大化,进而使肿瘤血管形成栓子闭塞,导致局部血供减少,瘤体逐渐萎缩,并刺激血管周围形成纤维包裹,限制瘤体生长,一次消除脉络膜血管瘤。小病灶 PDT 的优势在于光斑选择少、易覆盖瘤体、能量集中,在有限的时间内光敏剂可在瘤体中再循环和集聚,利于激光照射发挥最大效应。对于大病灶 CCH,治疗时间延长,需要的光斑数量增加,光敏剂再循环后肿瘤血管中药物含量减少,形成不了激光照射后的有效光斑反应,不易造成血管栓塞,故达不到单次治疗目的,反而容易刺激瘤体复发和扩大。而多次 PDT 易造成色素上皮损伤、视网膜脉络膜萎缩变性、含脂褐质的巨噬细胞或色素上皮细胞侵入、病灶及周围组织形成纤维化、黄斑损伤导致中心视力永久性丧失等[26-28]。

本研究聚焦波及黄斑中心凹下的小病灶 CCH 治疗前后形态和视功能变化,采用单次改良的 PDT 参数,11 例 PSCCH 患者手术均成功,术中和术后均未发生视网膜出血或渗出加重、视网膜脱离、视网膜血管栓塞、视网膜缺血等并发症,术后的 BCVA、瘤体厚度及直径大小均较术前有明显改善,表明选择合适的病例,特别是合适的瘤体厚度和直径大小是单次 PDT 成功的关键,合理的治疗参数是治疗成功的保障。与以往报道的大光斑、全覆盖治疗效果不同,改良的 PDT 参数优势在于根据瘤体基底直径和厚度进行个性化 PDT 设计和实践,避免了大光斑照射时对小血管的损害,小光斑多点重复照射有效避开了小血管,特别是视网膜分支小动脉,防止了视网膜分支动脉栓塞[28-30]。

本研究中 PSCCH 单次 PDT 后黄斑形态恢复显著。治疗前瘤体呈圆顶状隆起,伴视网膜下积液,治疗后 100% 瘤体缩小,视网膜下液吸收,黄斑形态恢复正常,随访未见瘤体复发和视网膜脱离。提示 PDT 治疗 PSCCH 后的瘤体变化、黄斑中心凹形态恢复与基线瘤体大小、瘤体厚度直接相关。

本研究发现 PSCCH 患者行 PDT 后视功能得以维持和改善。一方面研究中选择合适瘤体厚度和范围、瘤体小光斑、多斑重叠、避开视网膜主干和分支血管激光照射是患者术后视功能改善的关键。另一方面本组病例病程短,基线 BCVA 较好,这也是术后视功能恢复较好的重要原因,提示治疗后视功能变化与基线病灶大小、激光参数、病程和基线 BCVA 有关。本研究预示着 CCH 患者 PDT 治疗时间窗和瘤体大小、位置与治疗预后的相关性。单次 PDT 治疗 PSCCH 后瘤体萎缩,黄斑形态恢复,视功能稳定并改善,表明 PSCCH 可能是单次 PDT 治疗 CCH 的最佳适应证。

未纳入本研究的大病灶、伴发广泛视网膜脱离的脉络膜血管瘤,无论何种治疗方法都存在视网膜脉络膜脱离、瘤体变大和复发的可能。对于中度和较大的 CCH,或可选择联合治疗使肿瘤病灶缩小或肿瘤完全变平。虽然本次回顾性研究仅涉及一小部分 CCH 病例,但这是首次报道单中心特定 CCH 病例群体单次 PDT 结果,为 PSCCH 患者单次治疗适应证的选择提供了临床依据,建议 PSCCH 患者无论有无症状均可考虑单次 PDT 治疗,以期达到有效的瘤体部位形态恢复和视功能维持。本研究结果补充了 CCH 治疗的特定适宜人群和最佳治疗方式,提供了临床治疗 CCH 的新补充。但由于病例数少,研究结果可能有一定偏差,希望今后积累更多的资料,提供更多更准确的临床数据,进一步规范脉络膜血管瘤有序治疗,以达成 PDT 治疗 CCH 临床共识。

[参考文献]

[1] Shields CL, Honavar SG, Shields JA, et al. Circumscribed choroidal hemangioma: clinical manifestations and factors predictive of visual outcome in 200 consecutive cases[J]. Ophthalmology, 2001, 108(12): 2237 - 2248.

[2] Scott IU, Alexandrakis G, Cordahi GJ, et al. Diffuse and circumscribed choroidal hemangiomas in a patient with Sturge-Weber syndrome[J]. Arch Ophthalmol, 1999, 117: 406 - 407.

[3] Cheung D, Grey R, Rennie I. Circumscribed choroidal haemangioma in a patient with Sturge-Weber syndrome[J]. Eye (Lond), 2000, 14(2): 238 - 240. doi: 10.1038/eye.2000.61.

[4] Khuu T, Hoffman DJ. Circumscribed choroidal hemangioma: a case report and review of the literature[J]. Optometry, 2006, 77(8): 384 - 391. doi: 10.1016/j.optm.2006.06.002.

[5] Tsipursky MS, Golchet PR, Jampol LM. Photodynamic therapy of choroidal hemangioma in sturge-weber syndrome, with a review of treatments for diffuse and circumscribed choroidal hemangiomas[J]. Surv Ophthalmol, 2011, 56(1): 68 - 85. doi: 10.1016/j.survophthal.2010.08.002.

[6] Kamal A, Watts AR, Rennie IG. Indocyanine green enhanced transpupillary thermotherapy of circumscribed choroidal haemangioma[J]. Eye, 2000, 14(5): 701 - 705. doi: 10.1038/eye.2000.187.

[7] Wang GL, Wang MY, Wei WB. Transpupillary thermotherapy for circumscribed choroidal hemangiomas[J]. Zhonghua Yan Ke Za Zhi, 2012, 48(4): 318 - 322.

[8] Garcia-Arumi J, Ramsay LS, Guraya BC. Transpupillary thermotherapy for circumscribed choroidal hemangiomas[J]. Ophthalmology, 2000, 107(2): 351 - 356.

[9] Aizman A, Finger PT, Shabto U, et al. Palladium 103 (103Pd) plaque radiation therapy for circumscribed choroidal hemangioma with retinal detachment[J]. Arch Ophthalmol, 2004, 122(11): 1652 – 1656. doi: 10.1001/archopht.122.11.1652.

[10] Madreperla SA, Hungerford JL, Plowman PN, et al. Choroidal hemangiomas: visual and anatomic results of treatment by photocoagulation or radiation therapy[J]. Ophthalmology, 1997, 104: 1773 – 1778.

[11] Ritland JS, Eide N, Tausjo J. External beam irradiation therapy for choroidal haemangiomas. Visual and anatomical results after a dose of 20 to 25 Gy[J]. Acta Ophthalmol scand, 2001, 79: 184 – 186.

[12] Zeisberg A, Seibel I, Cordini D, et al. Long-term(4 years) results of choroidal hemangioma treated with proton beamirradiation[J]. Graefes Arch Clin Exp Ophthalmol, 2014, 252(7): 1165 – 1170. doi: 10.1007/s00417 – 014 – 2635 – 1.

[13] Zografos L, Egger E, Bercher L, et al. Proton beam irradiation of choroidal hemangiomas[J]. Am J Ophthalmol, 1998, 126: 261 – 268.

[14] Kivela T, Tenhunen M, Joensuu T, et al. Stereotactic radiotherapy of symptomatic circumscribed choroidal hemangiomas[J]. Ophthalmology, 2003, 110(10): 1977 – 1982. doi: 10.1016/S0161 – 6420(03)00483 – 4.

[15] Kubicka-Trząska A, Kobylarz J, Romanowska-dixon B. Ruthenium-106 plaque therapy for diffuse choroidal hemangioma in Sturge-Weber syndrome[J]. Case Rep Ophthalmol Med, 2011, 2011: 785686. doi: 10.1155/2011/785686.

[16] Sagong M, Lee J, Chang W. Application of intravitreal bevacizumab for circumscribed choroidal hemangioma[J]. Korean J Ophthalmol, 2009, 23(2): 127 – 131. doi: 10.3341/kjo.2009.23.2.127.

[17] Gupta M, Rundle PA, Rennie IG. Photodynamic therapy of circumscribed choroidal aemangioma[J]. Br J Ophthalmol, 2004, 88: 1414 – 1418. doi: 10.1136/bjo.2004.044396.

[18] Porrini G, Giovannini A, Amato G, et al. Photodynamic therapy of circumscribed choroidal hemangioma [J]. Ophthalmology, 2003, 110: 674 – 680. doi: 10.1016/S0161 – 6420(02)01968 – 1.

[19] Jurklies B, Bornfeld N. The role of photodynamic therapy in the treatment of symptomatic choroidal hemangioma[J]. Graefes Arch Clin Exp Ophthalmol, 2005, 243: 393 – 396. doi: 10.1007/s00417 – 004 – 1100 – y.

[20] Liu L, Hu C, Chen L, et al. Photodynamic therapy for symptomatic circumscribed choroidal hemangioma in 22 Chinese patients: a retrospective study[J]. Photodiagnosis Photodyn Ther, 2018, 24: 372 – 376. doi: 10.1016/j.pdpdt.2018.10.019.

[21] Naseripour M, Maleki A, Astaraki A, et al. Ruthenium-106 Brachytherapy in the treatment of circumscribed choroidal hemangioma[J]. Retina, 2018, 38(5): 1024 – 1030. doi: 10.1097/IAE.0000000000001616.

[22] Ho YF, Chao A, Chen KJ, et al. Clinical outcomes and predictors of response to photodynamic therapy in symptomatic circumscribed choroidal hemangioma: a retrospective case series[J]. PLoS One, 2018, 13(5): e0197088. doi: 10.1371/journal.pone.0197088.

[23] Elizalde J, Vasquez L, Iyo F, et al. Photodynamic therapy in the management of circumscribed choroidal hemangioma[J]. Can J Ophthalmol, 2012, 47(1): 16 – 20. doi: 10.1016/j.jcjo.2011.12.008.

[24] Zhang Y, Liu W, Fang Y, et al. Photodynamic therapy for symptomatic circumscribed macular choroidal hemangioma in Chinese patients[J]. Am J Ophthalmol, 2010, 150(5): 710 – 715. doi: 10.1016/j.ajo.2010.05.016.

[25] Gambrelle J, Graswill C, Mauget-Faysse M, et al. Treatment of circumscribed choroidal haemangiomas by photodynamic therapy: a review [J]. J Fr Ophtalmol, 2010, 33(7): 497 – 504. doi: 10.1016/j.jfo.2010.06.002.

[26] Junwon L, Christopher SL, Min K. et al. Retinal fluid changes and therapeutic effects in symptomatic circumscribed choroidal hemangioma patients: a long-term follow up study[J]. BMC Ophthalmol, 2018, 18(1): 321. doi: 10.1186/s12886 – 018 – 0993 – x.

[27] Li YJ, Sandinha T, Kerr JM, et al. Treatment review of sight threatening circumscribed choroidal haemangioma [J]. Int J Ophthalmol, 2010, 3(2): 168 – 171. doi: 10.3980/j.issn.2222 – 3959.2010.02.18.

[28] Su ZA, Tang XJ, Zhang LX, et al. Comparison of outcomes between overlapping-spot and single-spot photodynamic therapy for circumscribed choroidal hemangioma [J]. Int J Ophthalmol, 2014, 7(1): 66 – 70. doi: 10.3980/j.issn.2222 – 3959.2014.01.12.

[29] Marcus A, Shu-Yen Lee. Multifocal photodynamic therapy for diffuse choroidal hemangioma [J]. Clin Ophthalmol, 2012, 6: 1467 – 1469. doi: 10.2147/OPTH.S35471.

[30] Verbraak FD, Schlingemann RO, Keunen JE, et al. Longstanding symptomatic choroidal hem-angiomamanaged with limited PDT as initial or salvage therapy[J]. Graefes Arch Clin Exp Ophthalmol, 2003, 241: 891 – 898. doi: 10.1007/s00417 – 003 – 0765 – y.

[31] Cerman E, Cekic O. Clinical use of photodynamic therapy in ocular tumors[J]. Surv Ophthalmol, 2015, 60(6): 557 – 574. doi: 10.1016/j.surv ophthal.2015.05.004.

[32] Kwon HJ, Kim M, Lee CS, et al. Treatment of serousmacular detachment associated with circumscribed choroidal hemangioma[J]. Am J Ophthalmol, 2012, 154(1): 137 – 145. e1. doi: 10.1016/j.ajo.2012.01.007.

[33] Vicuna-Kojchen J, Banin E, Averbukh E, et al. Application of the standard photodynamic treatment protocol for symptomatic circumscribed choroidal hemangioma[J]. Ophthalmologica, 2006, 220: 351 – 355. doi: 10.1159/000095859.

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